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TECHNOLOGY DEPT.
TWO SHILLINGS & SIXPENCE

Plastics

DEALING WITH THE MANUFACTURE, USES AND POTENTIALITIES OF PLASTIC MATERIALS

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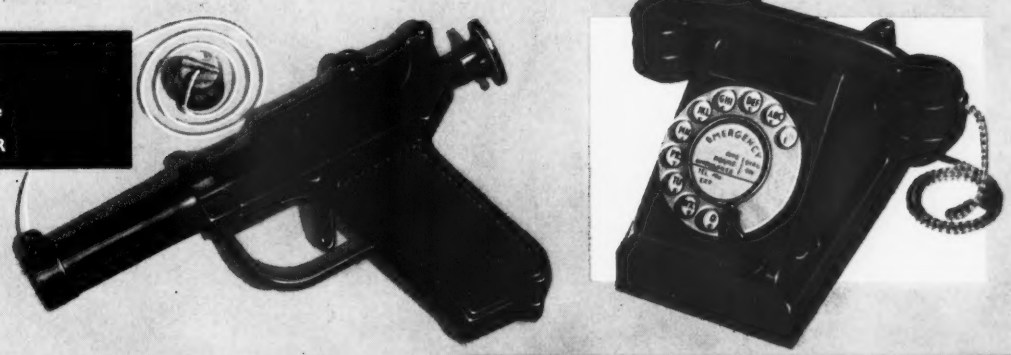
DETROIT

BEXOID
Cellulose Acetate
MOULDING POWDER

Preferred by experienced toy moulders

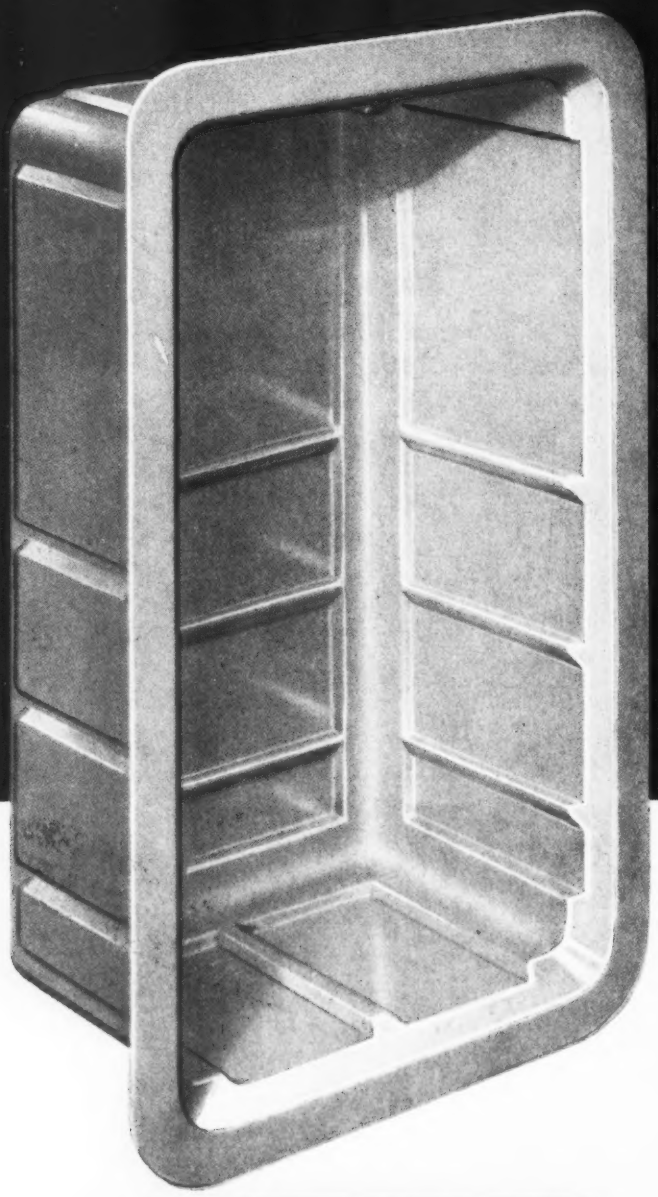
B.C.15
Toughened polystrene
MOULDING POWDER



Mouldings in Bexoid Bextrene and B.C. 15 Toughened Polystyrene by Wells-Brimtoy Distributors Ltd.

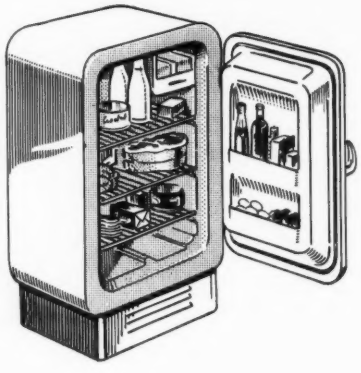
BEXTRENE
Polystyrene MOULDING POWDER

BX PLASTICS LIMITED Higham Station Avenue, London, E.4.
Subsidiary of the British Xylonite Company Limited.



Refrigerator Liner—**vacuum formed** by the 'Formvac Airslip' technique developed by Messrs. Hydro-Chemie, using Erinoid extruded high impact polystyrene sheeting, grade CP.20X, with high gloss finish on one side. Thickness ·125".

Dimensions of moulding
18" x 33" x 12½"



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Styrene Copolymer Sheeting

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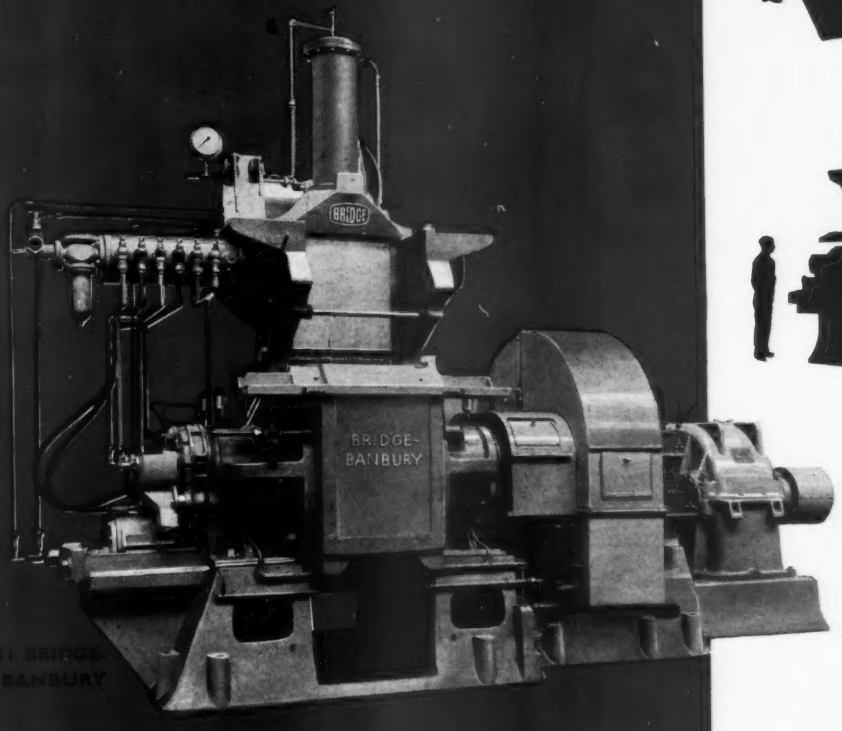
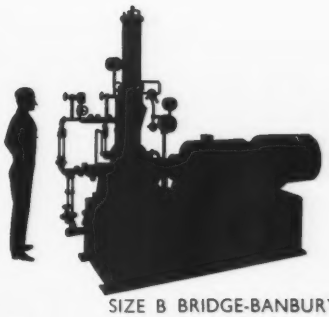
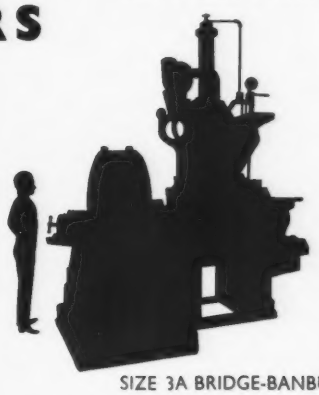


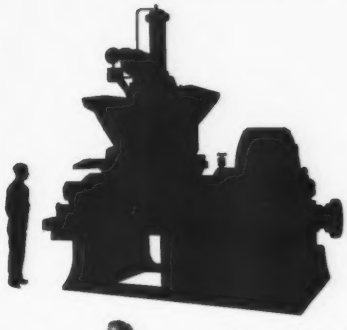
SIZE 11 BRIDGE-BANBURY



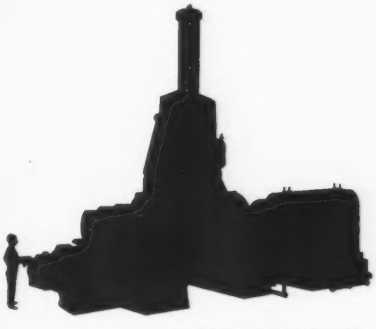
SIZE B BRIDGE-BANBURY



SIZE 3A BRIDGE-BANBURY



SIZE 9 BRIDGE-BANBURY



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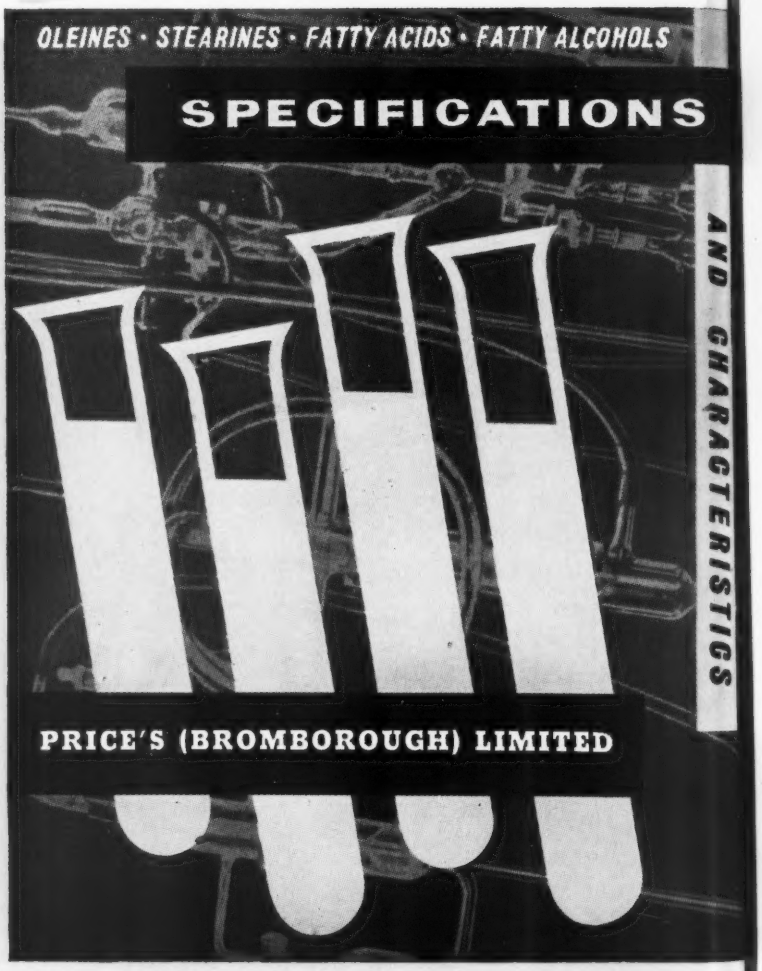

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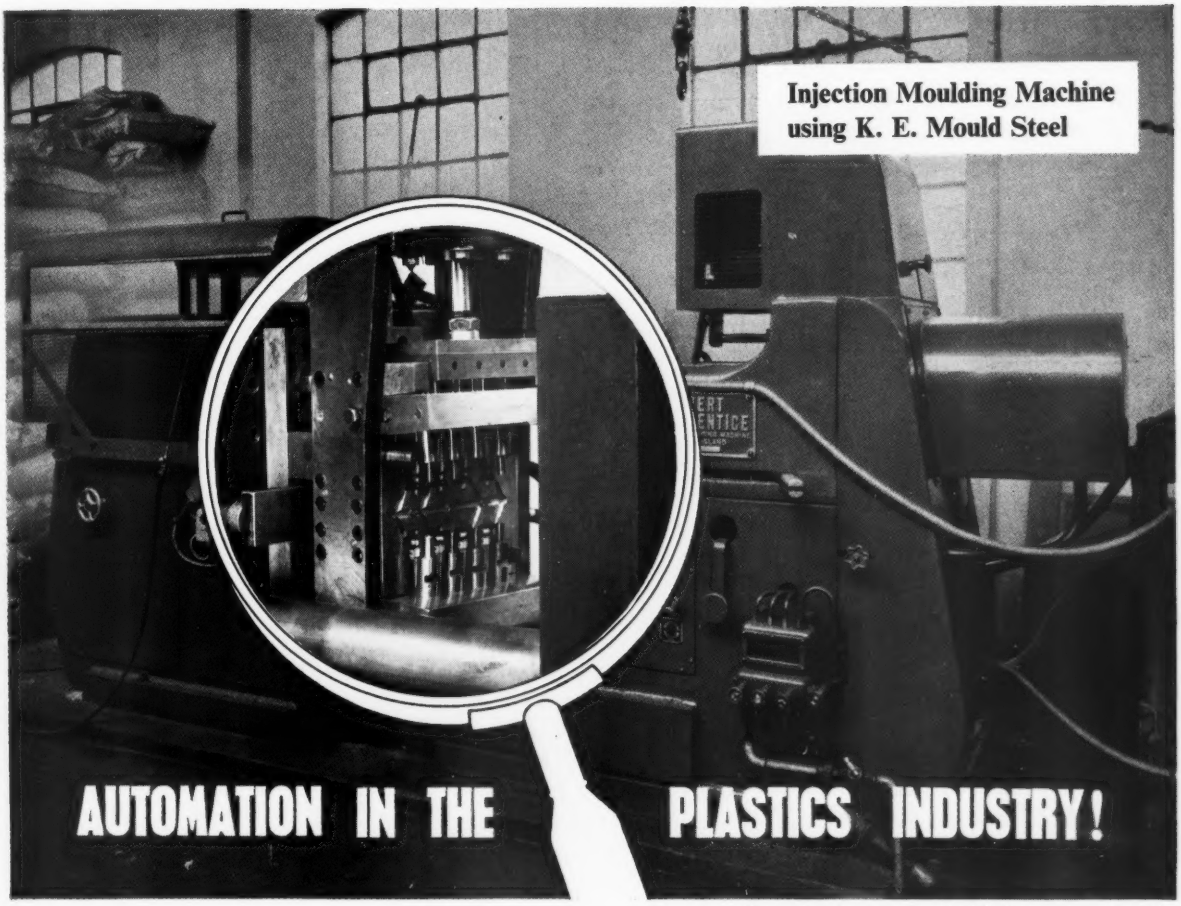

Illustration by courtesy of Wolseley Engineering Ltd.

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(KE) 355 Special Nickel Chrome Molybdenum Oil or Air Hardening Mould Steel.

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Melted to close limits of analysis. Forged with an adequate reduction of area from the ingot to ensure the maximum amount of grain distortion. Carefully annealed to give optimum machinability and grain refinement. Ultrasonically inspected prior to despatch. These factors and almost one and a half centuries of steel-making experience give our Steels a high degree of regularity and reliability. These Steels have great strength and do not distort under the high pressure of injection moulding.

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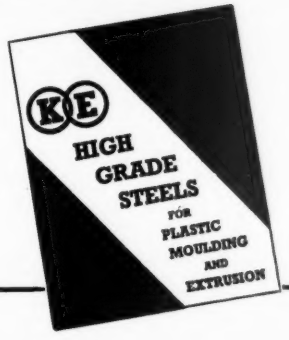

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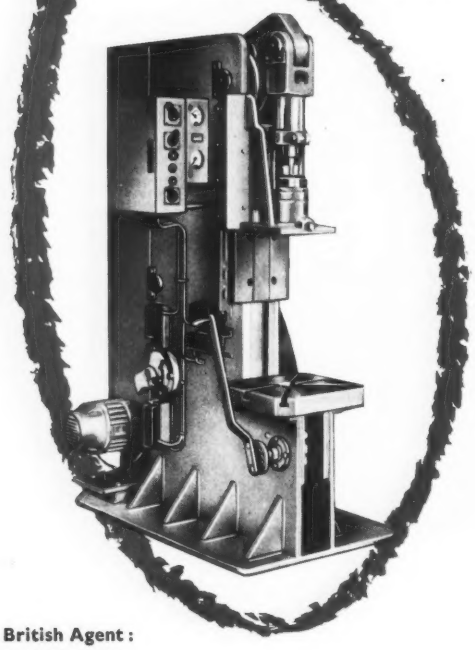

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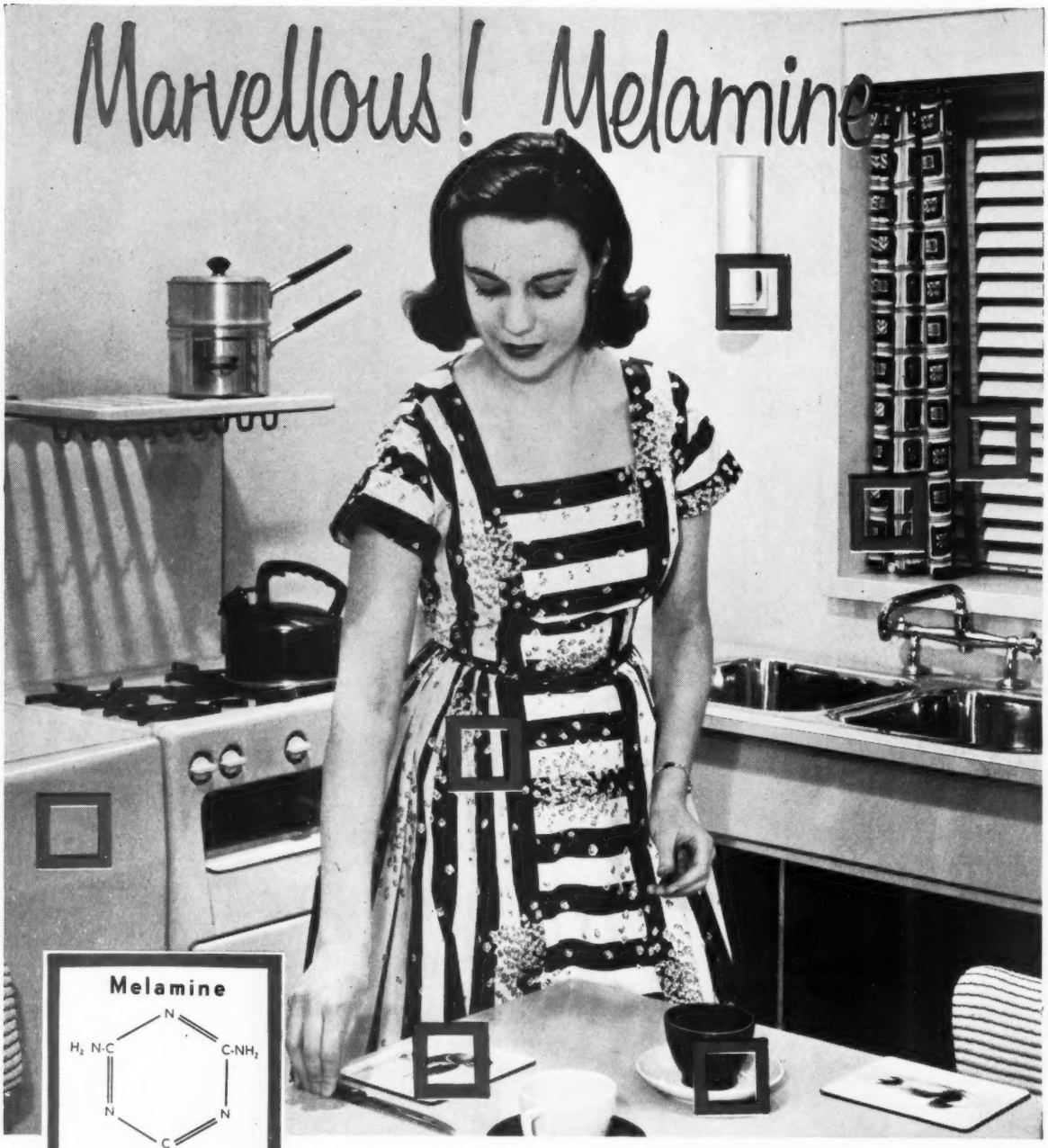

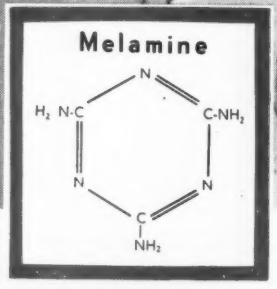

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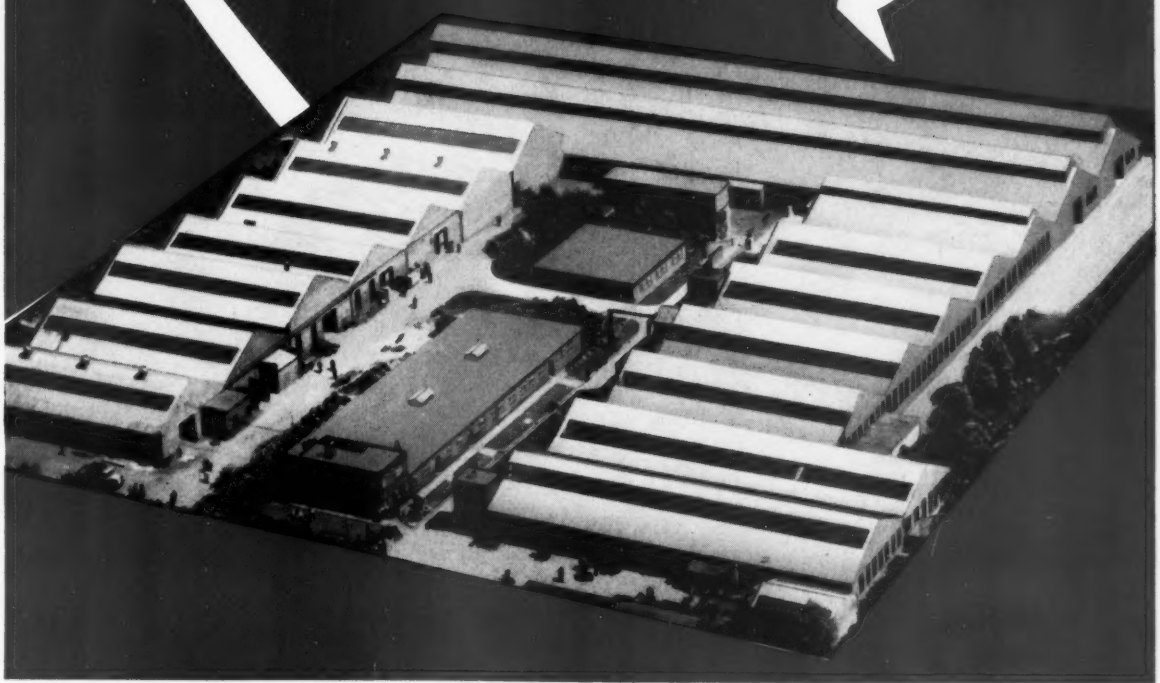

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- High speed injection unit increases plasticizing rate, and fast injection plunger speed reduces cycle times.
- Accurate compensating weigh feeders, and an extra timer permit double feeding of material for large capacity shots.
- Dual injection pump for two-speed injection or dual pressure injection, as desired.
- Silent pumps supply hydraulic power for maximum clamping pressure and operation of clamp and injection rams.
- All hydraulic components are readily accessible. A minimum of pipe lines permits easy interchange of valves without interference.

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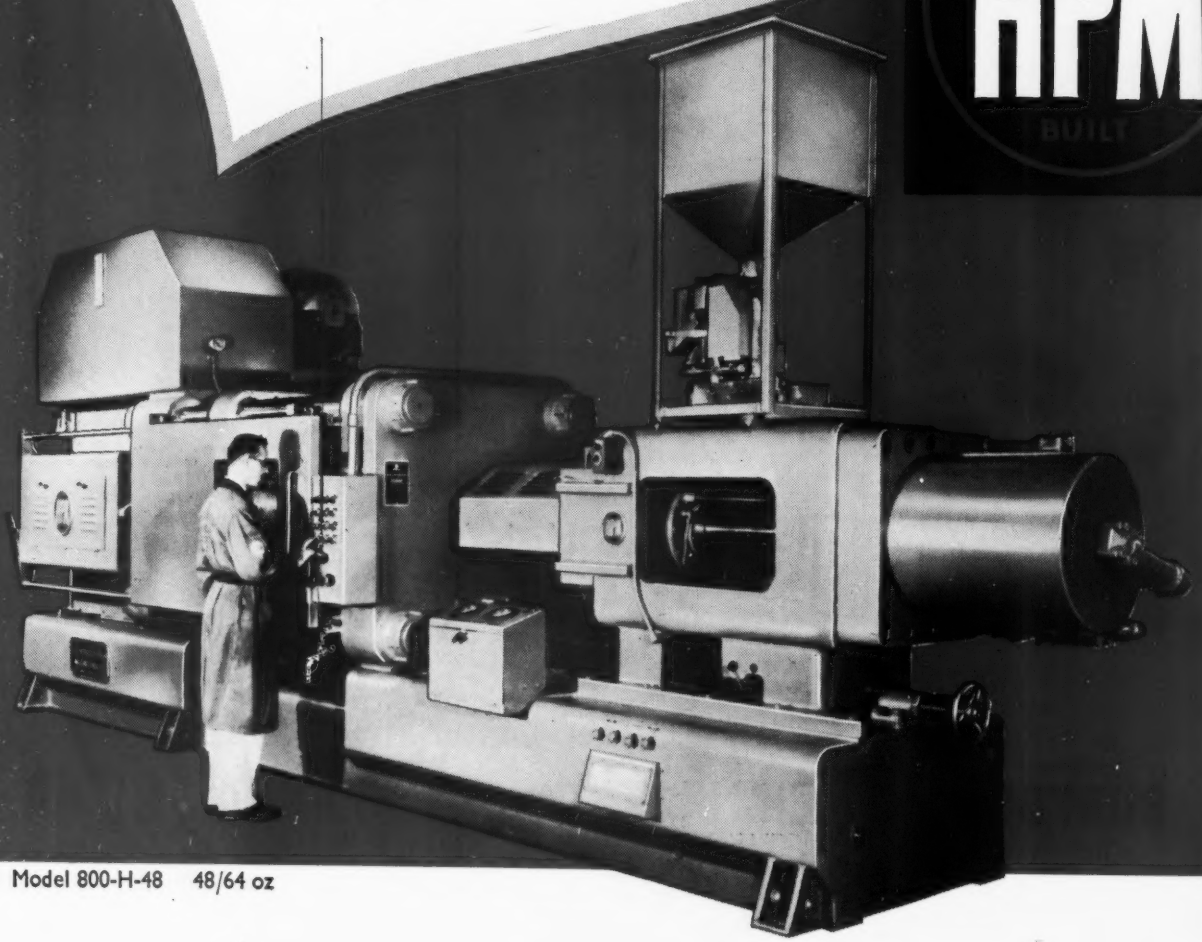

Model 800-H-48 48/64 oz

at lower cost per shot

Step up production with H.P.M. machines — the fastest injection moulders producing thermo-plastic parts at lower cost per shot than any other machines of comparable size.

They are fully automatic "all-hydraulic" machines possessing many outstanding features providing faster cycle times, powerful clamping and easy set-up, accurate material feed and high plasticizing capacity.

In addition, they are economical with labour, floor space and material, and are dependable too. The machines range in size to meet every moulding need, and each unit is backed by over seventy years' specialist service.

PLASTICS INJECTION MACHINES

SPECIFICATIONS

	Model 300-H-12	Model 400-H-20	Model 600-H-40
Volume moulded per shot (cu. ins.)	20	34	81
Weight moulded per shot (ozs.)	12	20	48
A prepacking or double stroke feed (ozs.) ...	16	28	64
Plasticizing capacity (lbs./hour)	135	200	300
Rate of injection (cu. ins./second)	16	17·3	40
Size of die plates	30" x 33"	36" x 42"	55" x 55"
Space between bars	17" x 20½"	21" x 27"	36½" x 36½"
Mould opening stroke	20"	25"	35"
Maximum die space	30"	40"	55"
Maximum die space with spacer	26"	34"	47"
Minimum die space	10"	15"	20"
Minimum die space with spacer	6"	9"	12"
Mould locking force (U.S. tons)	300	400	800
Mould locking force (long tons)	268	268	715
Capacity of hopper (lbs.)	100	100	350
Power consumption of heating units when plasticizing at full capacity (kW.)	21·8	25·4	37·6
Motor required	40 h.p. nominal	50 h.p. nominal	100 h.p. and 20 h.p. nominal
Shipping weight (long tons)	9·8	17·5	33·5
Overall length and width	18' 6" x 5' 5"	28' 6½" x 5' 7"	38' 3" x 7' 1"

All injection capacities specified above are for general purpose polystyrene.

Details of other H.P.M. plastics injection machines on application.

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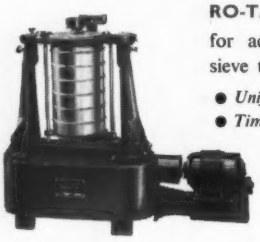
Laboratory Equipment

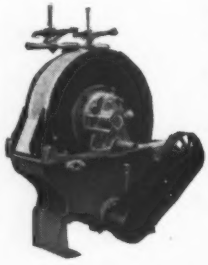


RO-TAP SIEVE SHAKER—
for accurate and consistent sieve testing.

- *Uniform mechanical action.*
- *Time switch control.*
- *Accommodates up to thirteen 8″ diameter sieves.*

SAMPLE SPLITTER—
to reduce a large sample for making sieve tests.

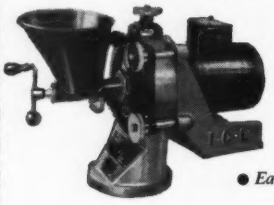
- *Made in two sizes for heavy tinned steel.*
- *No. 1: Eighteen ½″ openings.*
- *No. 2: Sixteen 1″ openings.*
- *Both sizes discharge alternately in opposite directions.*



ROVAC LABORATORY FILTER—
complete working reproduction of larger machine.

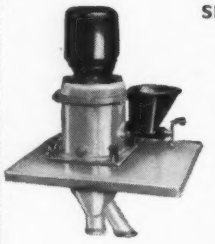
- *Built on cell principle: 3 sq. ft. filtering area.*
- *Belt drive, fast and loose pulleys.*

RAYMOND LABORATORY MILL—
grinding non-abrasive materials.



- *Rotor has eight steel swing hammers and runs at high speed.*
- *Supplied with five perforated steel screens, of different sizes, to suit product.*
- *Easily dismantled for cleaning.*

RAYMOND LABORATORY SEPARATOR—
self-contained air unit for dry particle size classification.



- *Separating chamber encloses all rotating parts.*
- *Simple to dismantle and clean. Fan and whizzer combination easily changed to suit product.*
- *Motor bearings grease-packed. No oiling required for separator parts.*

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for heat control ± 2°C

...at a price that won't raise your temperature!

BIPEL now offers a complete range of mains frequency induction heating platens and controllers for any press. This is the logical, economical, efficient heating system already proved in practice by BIPEL moulders and now available to all at realistic prices.

The BIPEL Temperature Controller maintains temperature at the required value by supplying, at short intervals, pulses of heat which balance up heat losses over a similar period of time. Used in conjunction with induction heated platens or moulds, it maintains an accurate temperature control within the limits of ±2°C.

PLATEN SIZE		12 INS 30·5 CMS	14 INS 35·6 CMS	16 INS 40·7 CMS	18 INS 45·87 CMS	20 INS 50·8 CMS	24 INS 61·0 CMS	28 INS 71·2 CMS	30 INS 76·2 CMS
LOADING K.V.A.	50C	1·73	2·35	3·1	4·0	5·0	7·0	9·0	10·5
	60C	1·42	1·96	2·58	3·34	4·17	5·84	7·5	8·75
SUPPLY A.C. ONLY	PHASES	1	1	1	1	1	3	3	3
50/60 CYCLES	VOLTS	220/240	220/240	220/240	220/240	220/240	220 380/420	220 380/420	220 380/420

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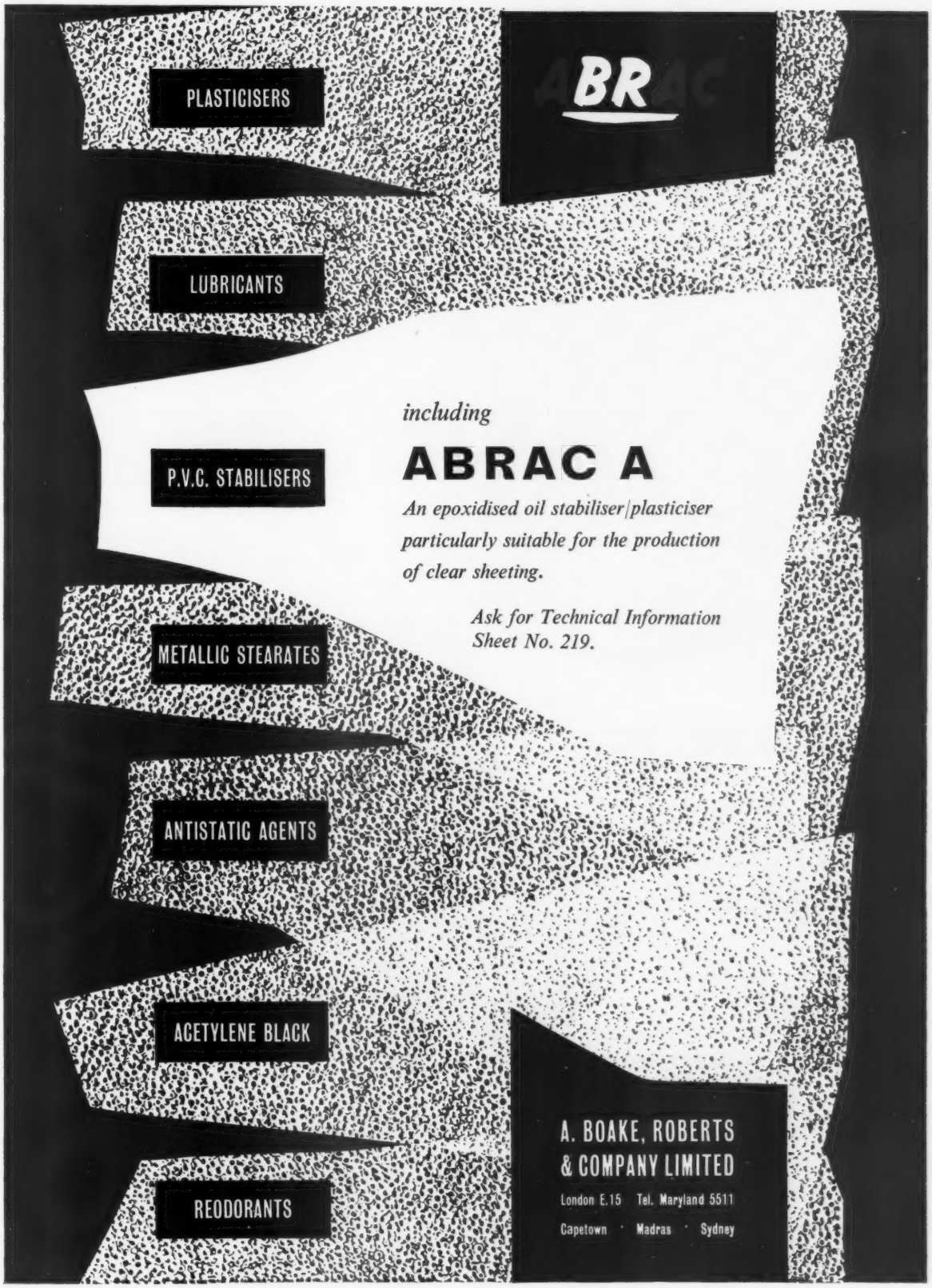
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made by Boots Ltd.

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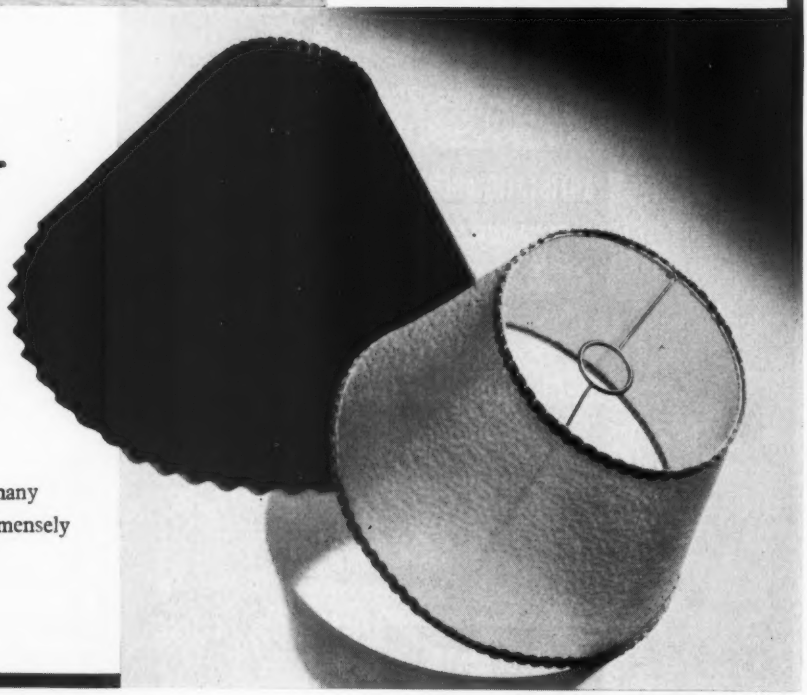
'Cellastine' throws new light on lampshade design with these strong, washable and colourful shades. They're proving so attractive and serviceable in so many homes — it's easy to see how immensely versatile 'Cellastine' can be !



BRITISH CELANESE LIMITED

Plastics Division, Celanese House, Hanover Square, London, W.1.

'Celastoid'

SLICED ACETATE

sheet

is used in so many ways . . .

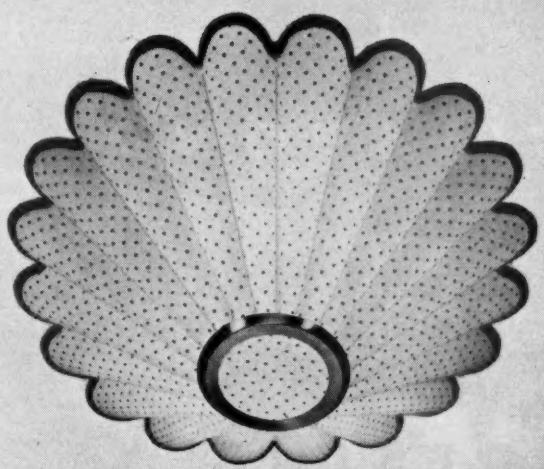
Made from colourful 'Celastoid' by J. & R. Fleming Ltd., these modern spectacle frames add glamour to good looks.

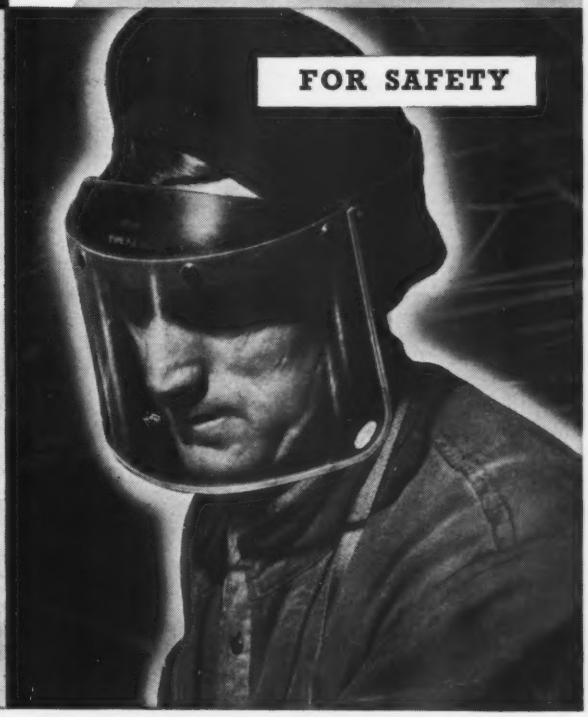
The ceiling light by Modern Lampshades Ltd. is strong, durable, washable . . . it throws fresh light on the versatility of 'Celastoid'.

Tough and shatterproof, crystal-clear 'Celastoid' keeps splinters and sparks where they belong! Visor is by Safety Products Ltd.

FOR GLAMOUR

FOR THE HOME





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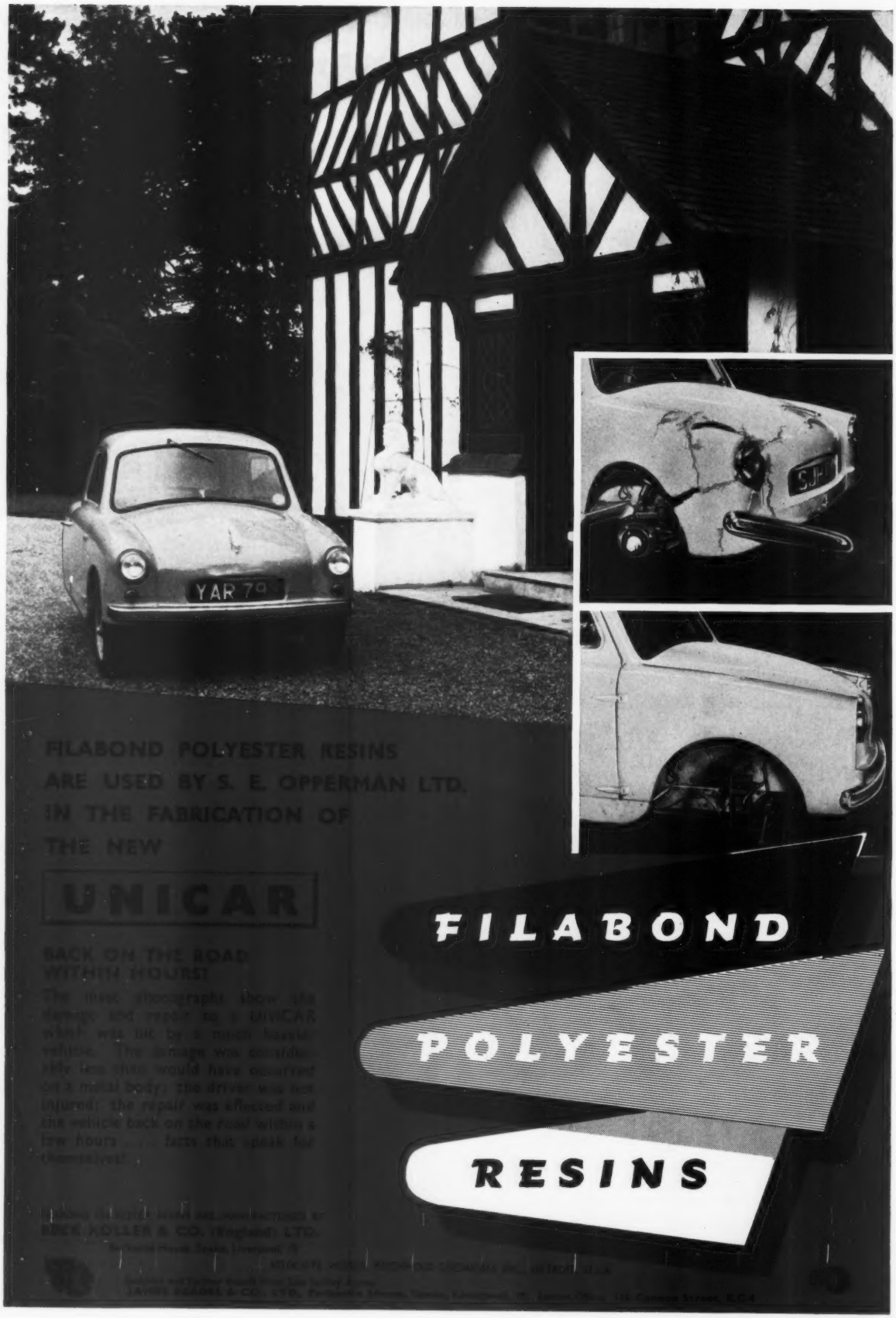
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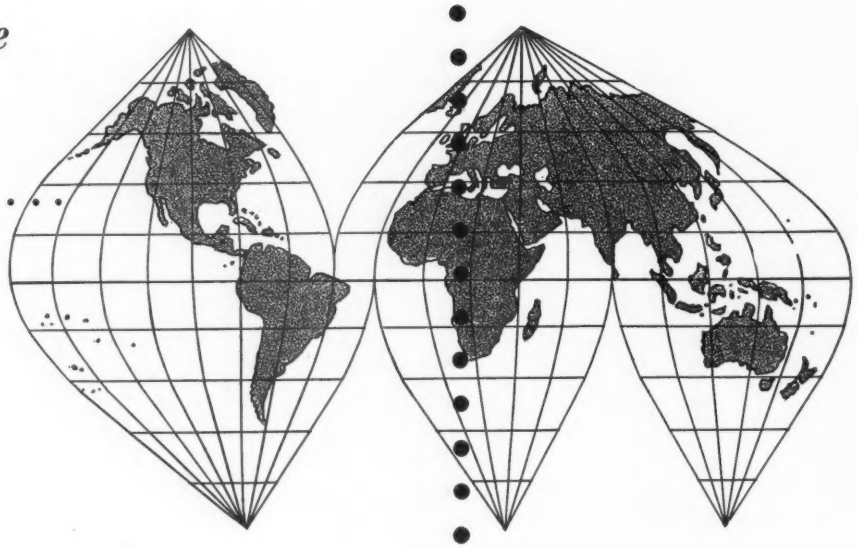

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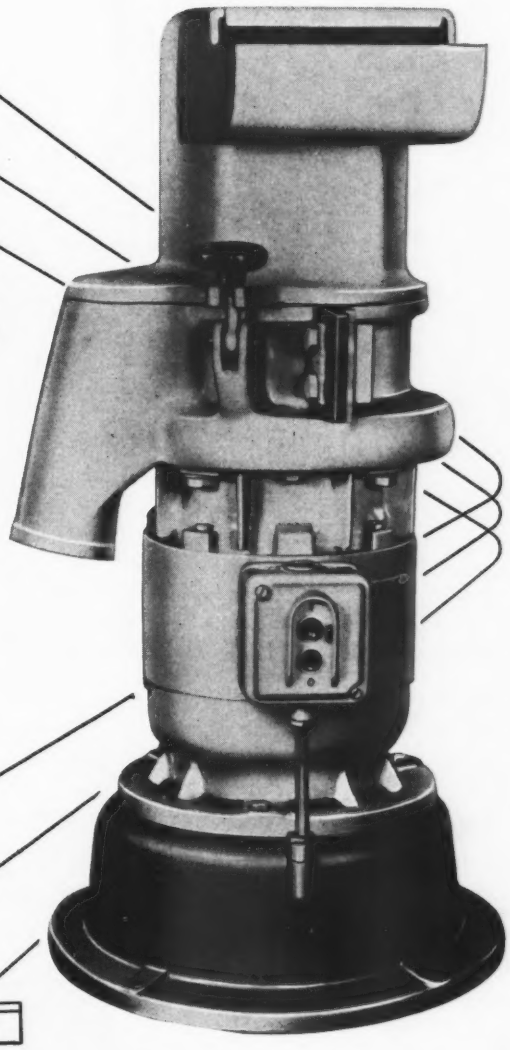

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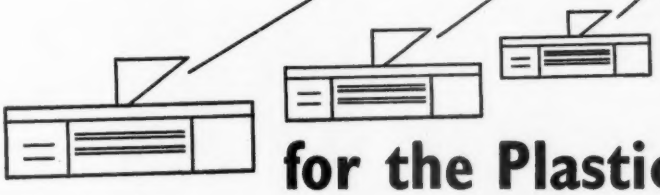

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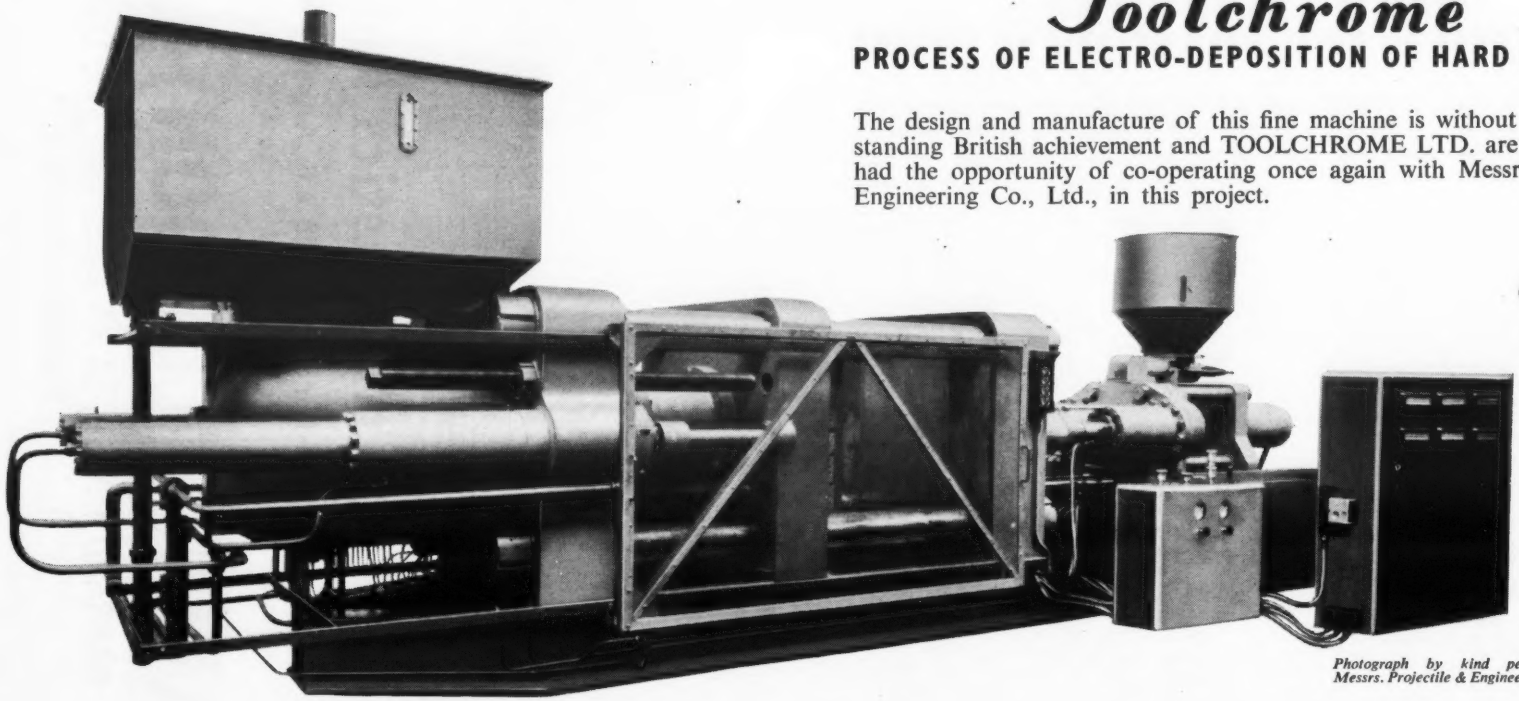

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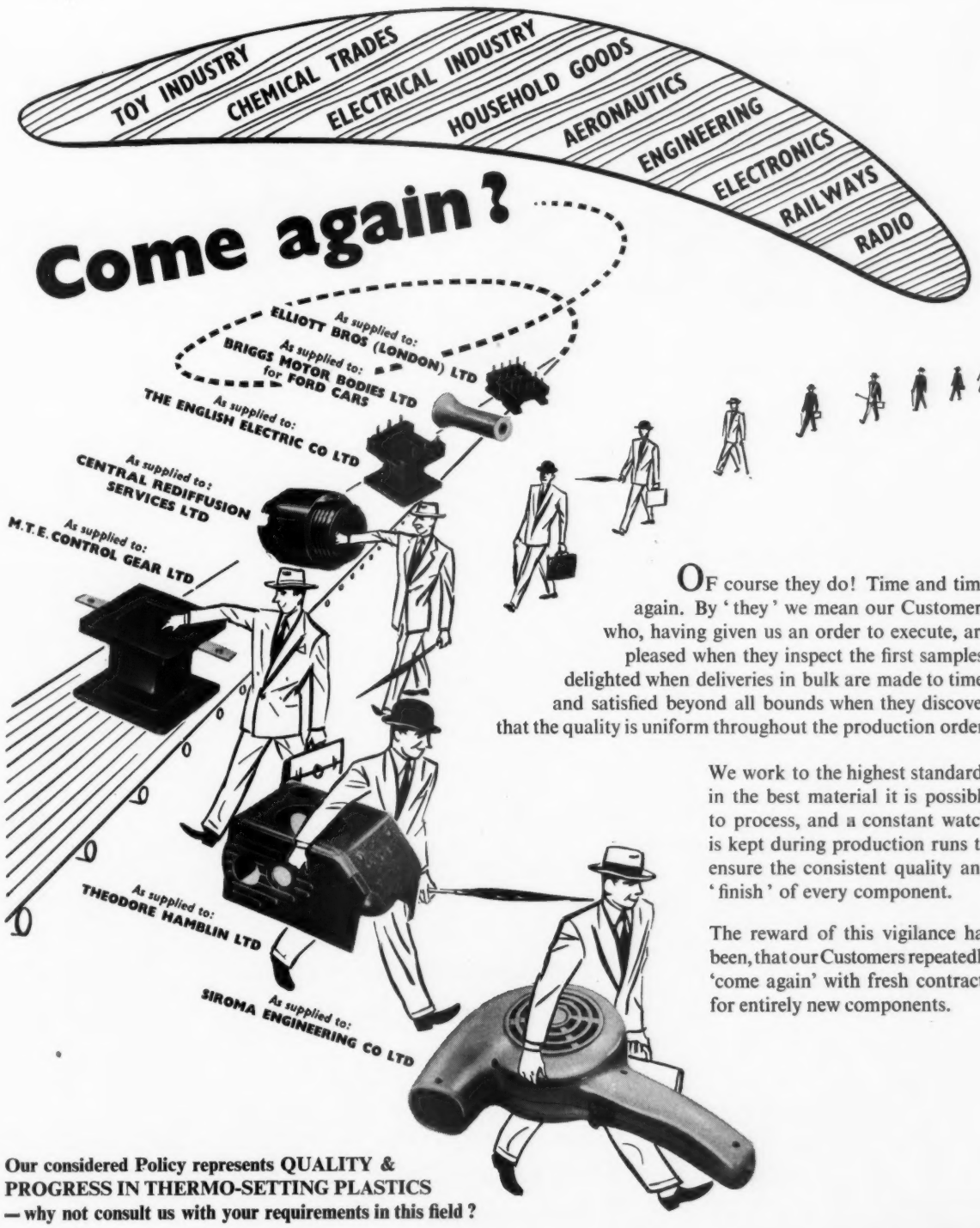

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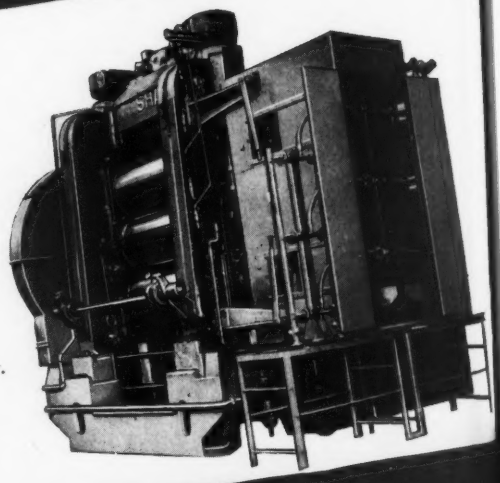

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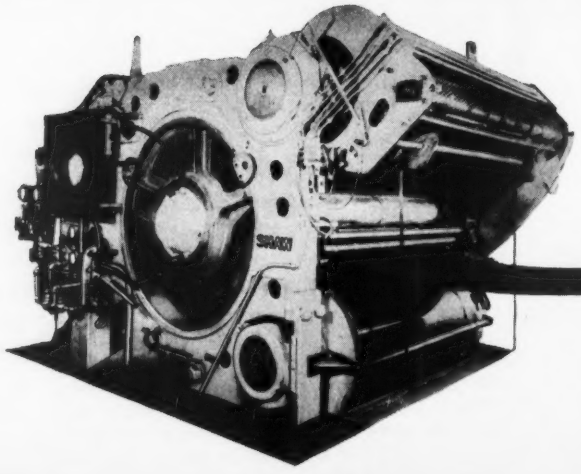

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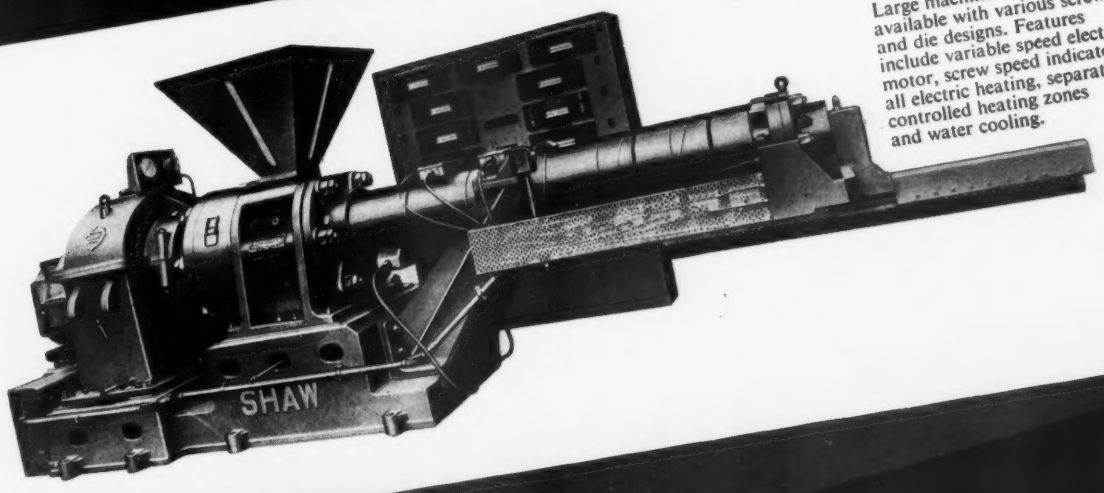

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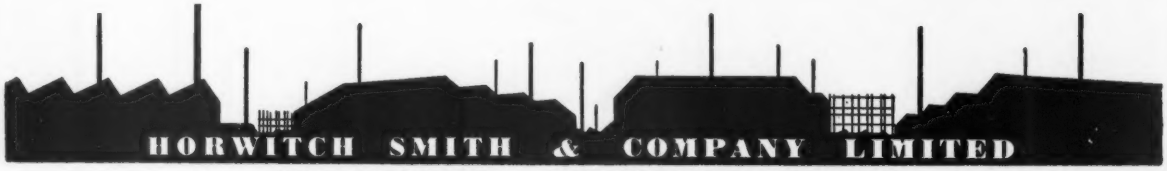

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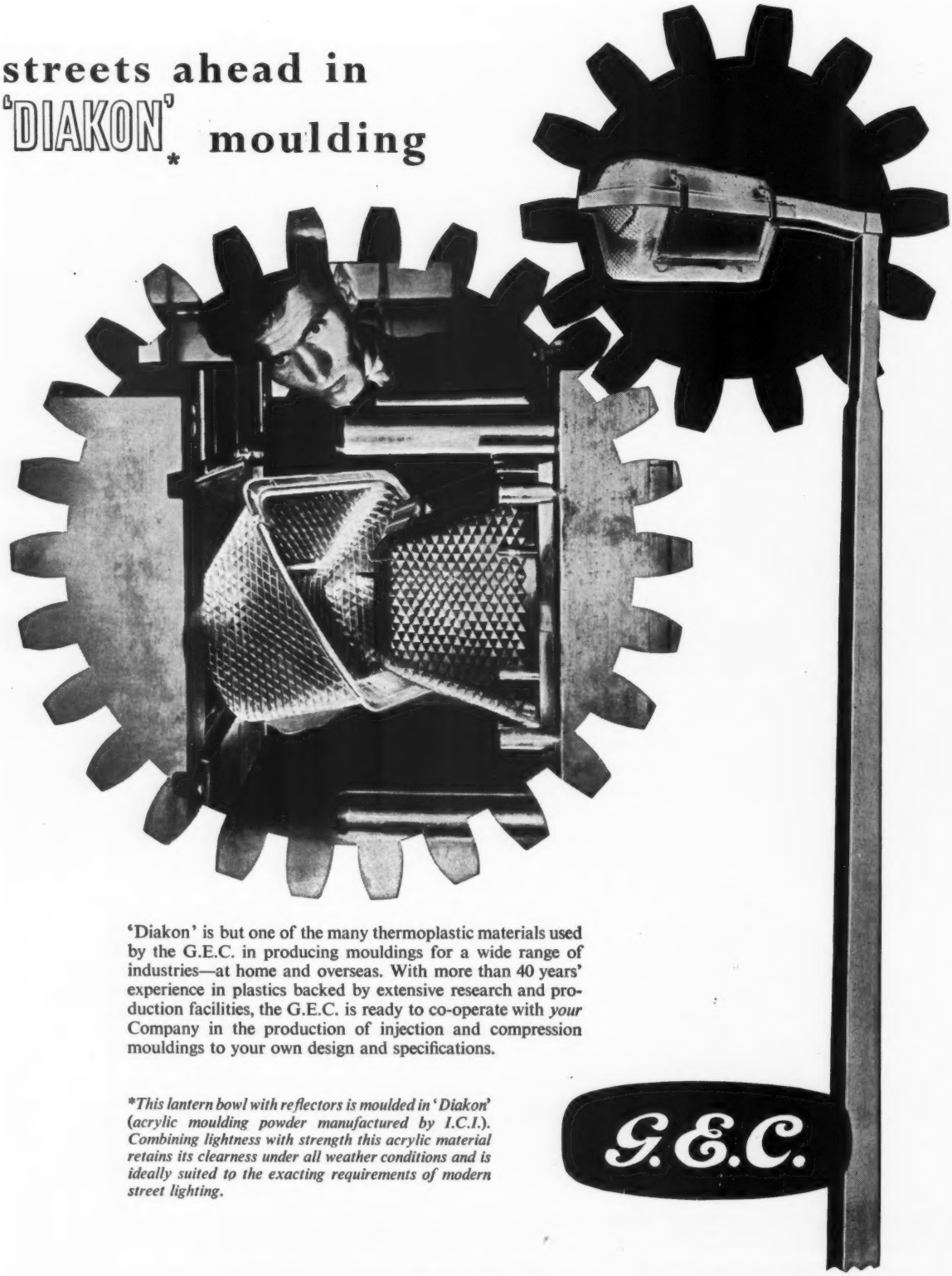
streets ahead in 'DIAKON'* moulding



'Diakon' is but one of the many thermoplastic materials used by the G.E.C. in producing mouldings for a wide range of industries—at home and overseas. With more than 40 years' experience in plastics backed by extensive research and production facilities, the G.E.C. is ready to co-operate with *your* Company in the production of injection and compression mouldings to your own design and specifications.

**This lantern bowl with reflectors is moulded in 'Diakon' (acrylic moulding powder manufactured by I.C.I.). Combining lightness with strength this acrylic material retains its clearness under all weather conditions and is ideally suited to the exacting requirements of modern street lighting.*

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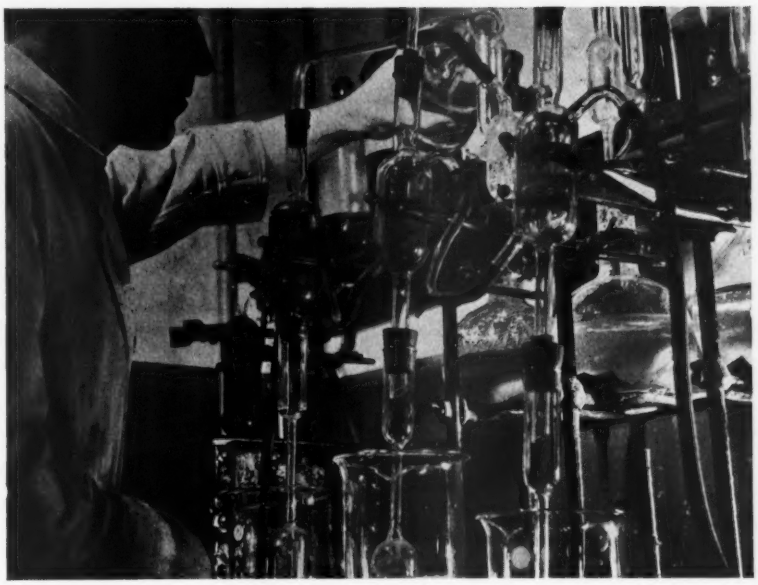

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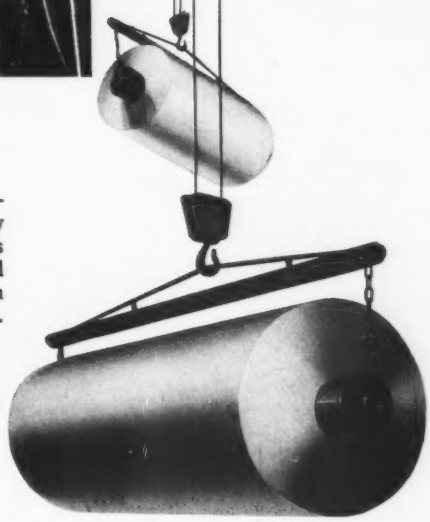

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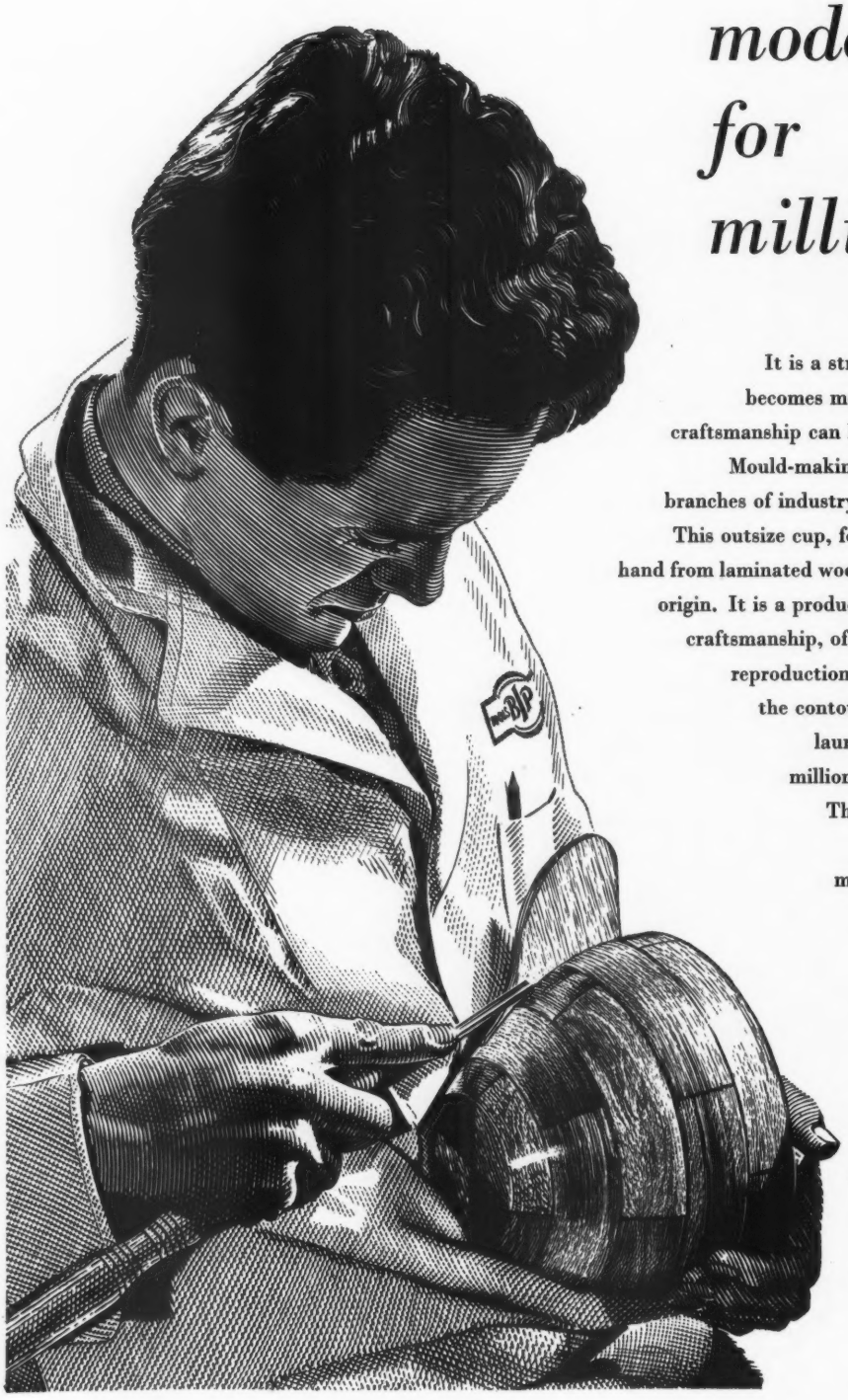

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It is a strange reflection that, as industry becomes more mechanised, the premium on craftsmanship can become increasingly emphasised. Mould-making is one of those small but basic branches of industry of which this is especially true. This outsize cup, for instance, is being modelled by hand from laminated wood with simple tools of traditional origin. It is a product of hand and eye, of controlled craftsmanship, of faultless precision. Scaled down reproduction from this master will determine the contours of the multi-impressions that launch in tens of thousands, or even millions, a new product on the market. That product will owe much to the personal skill of the individual model-maker and to the combined toolmaking skill of all the Craftsmen of Tyburn Road.

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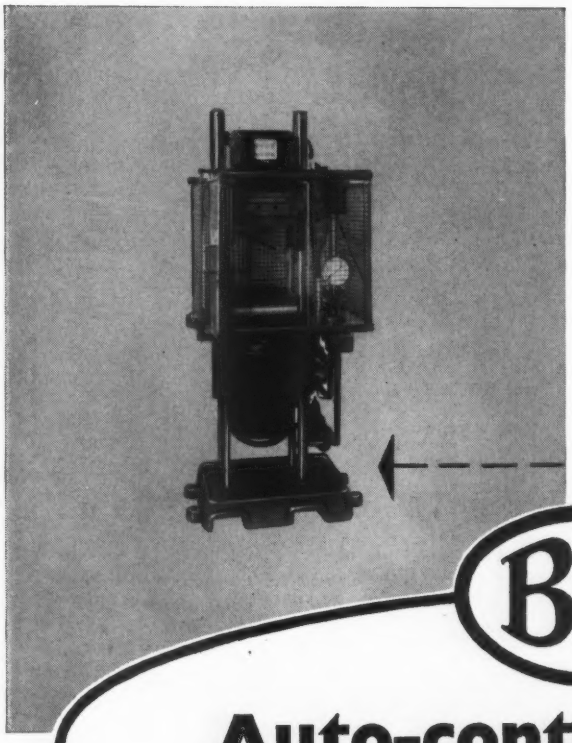

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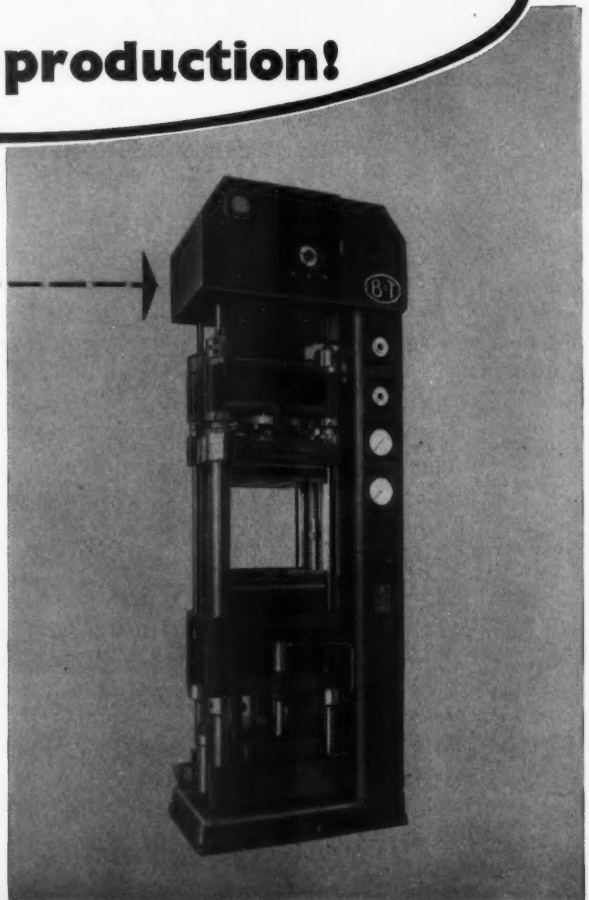

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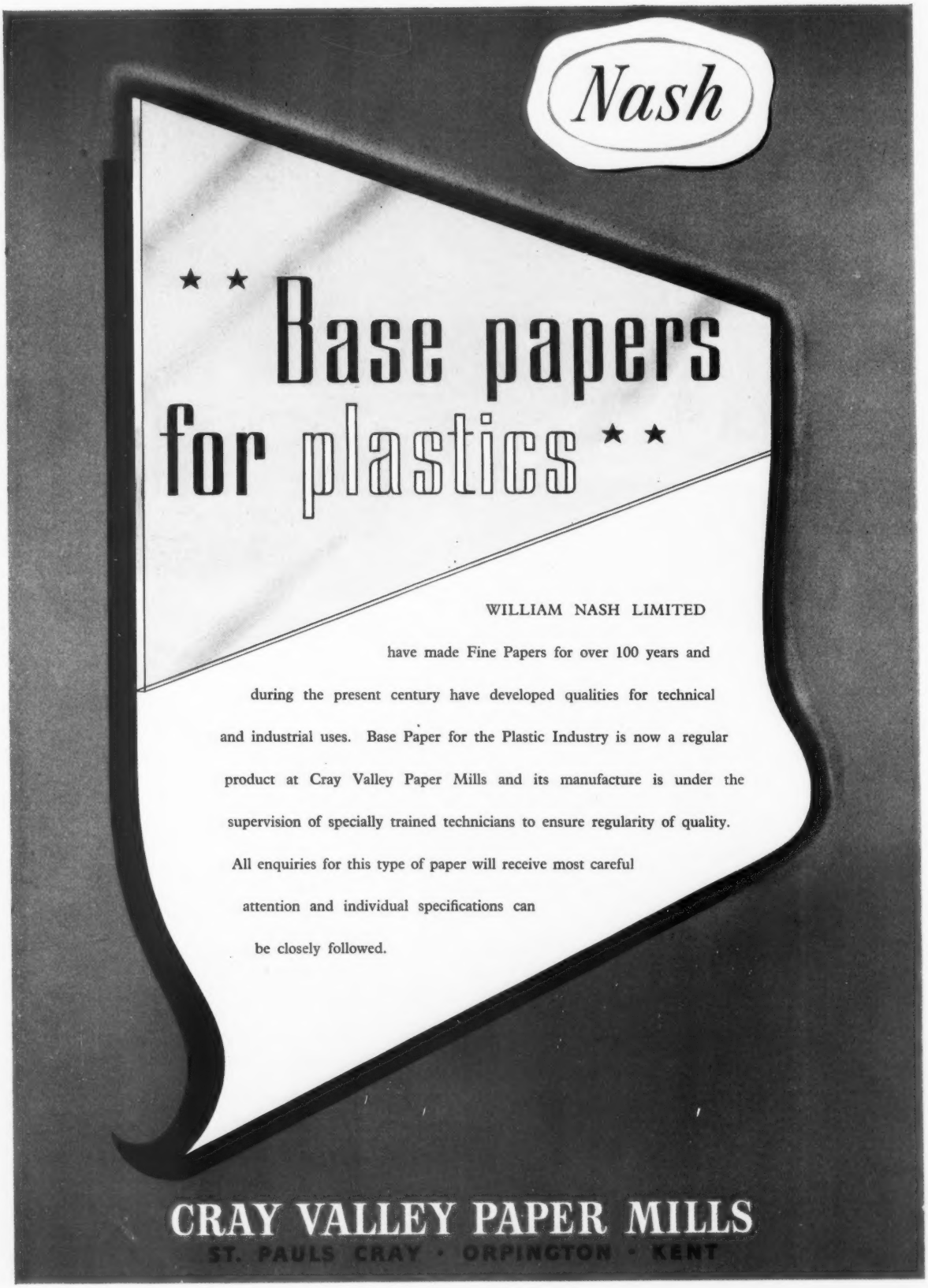
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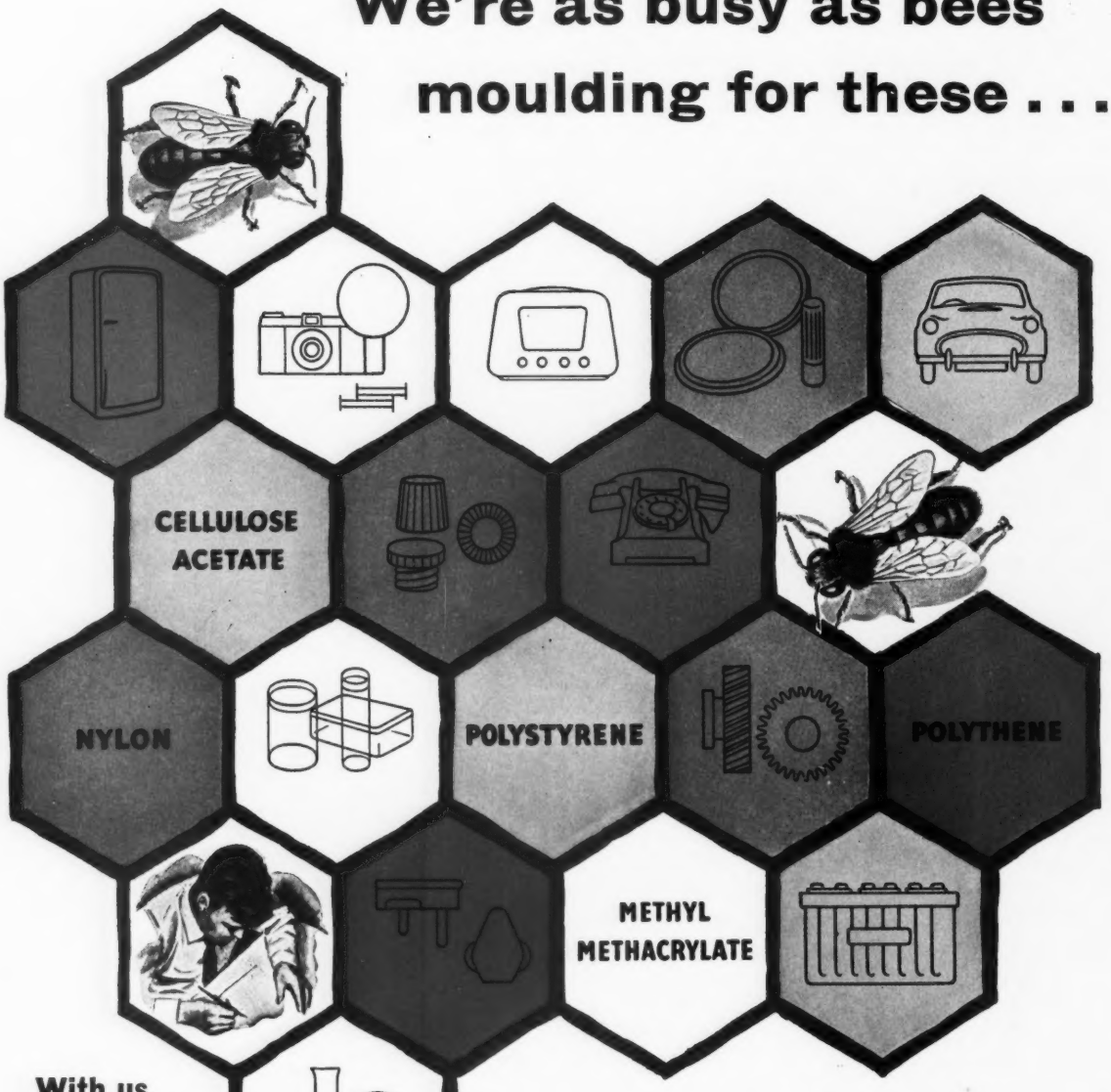
ON Shop-window

We're as busy as bees moulding for these . . .



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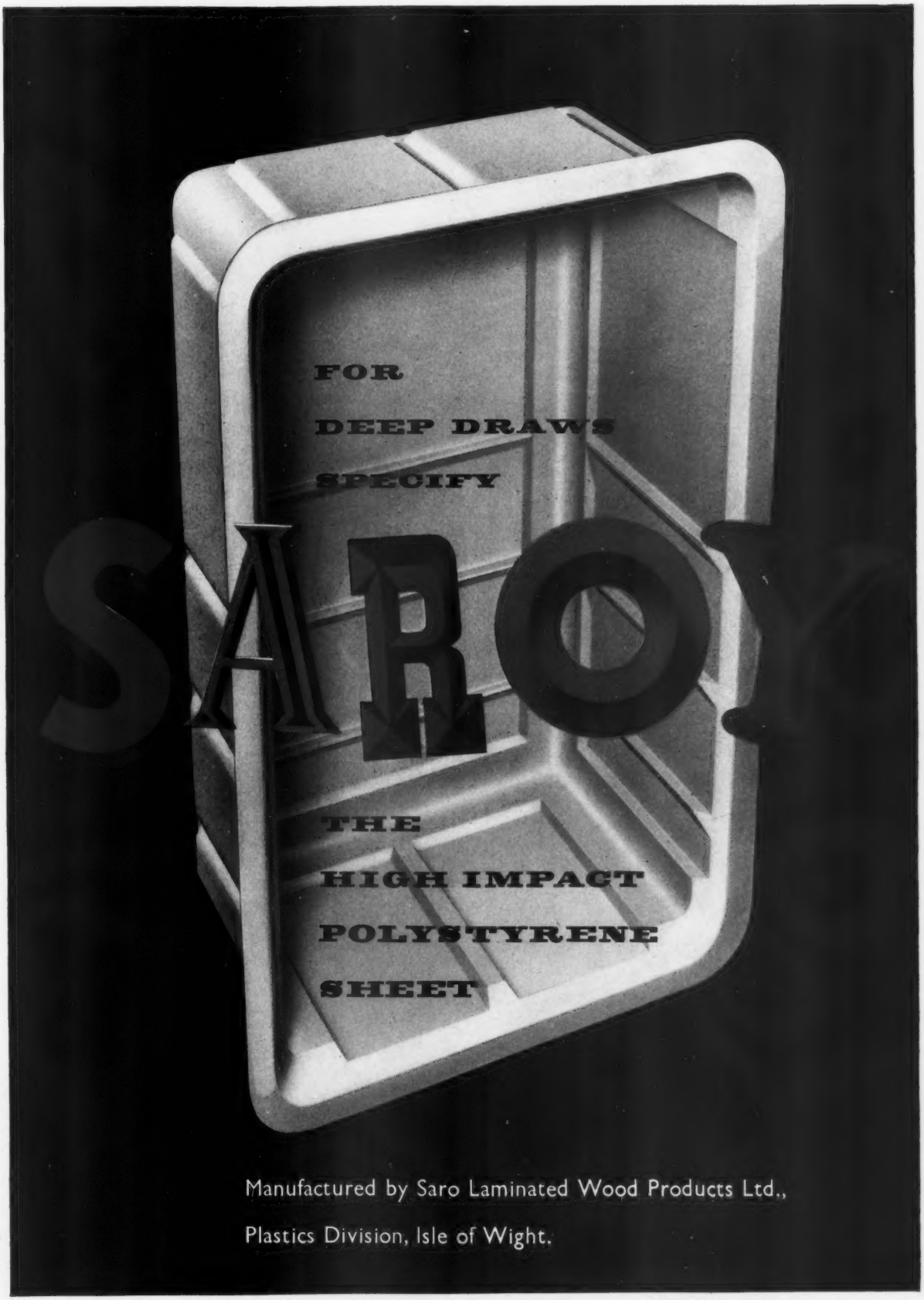

● *This Refrigerator Liner, made from ·125" thickness SAROY, measures 19½" x 33½" x 12¾" deep.*

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About the year 850 B.C. Ashur-Nasir-Pal, King of the Assyrians, by his conquests in the ancient world, formed a vast empire and commanded the peoples' respect by virtue of his undoubted superiority; he was one of the many personalities who helped to mould the history of the world. . . . Just as today NESTORITE MOULDING POWDERS are commanding respect in the moulding of products which will influence the world of tomorrow.

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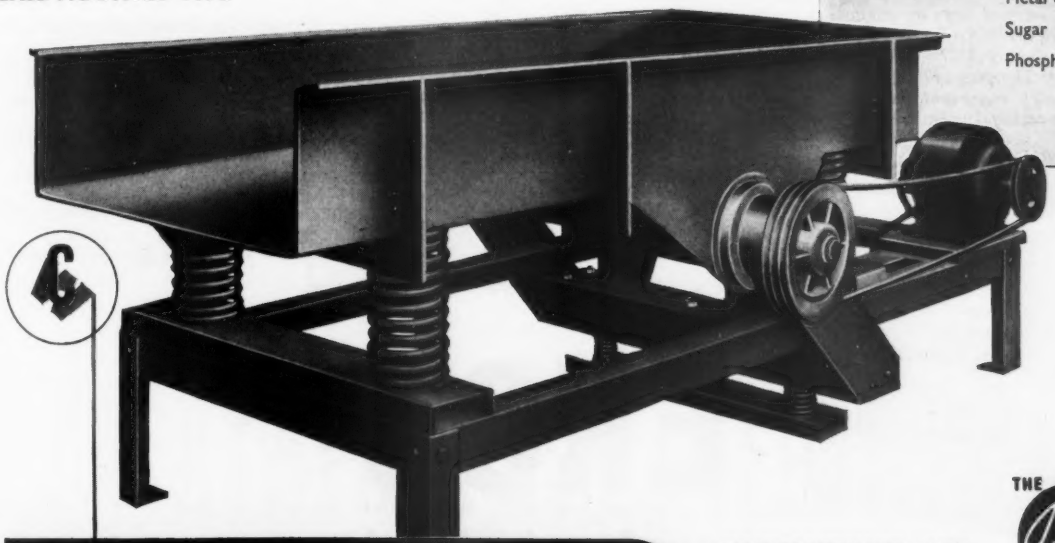
Ores	Salt
Limestone	Steel Mill Ends
Refractories	Castings
	Metal Chips
	Sugar
	Phosphate

BASE MOUNTED TYPE



THE **COLEMAN-WALLWORK COMPANY LIMITED**

MANUFACTURED AND SOLD UNDER LICENCE FROM HEWITT-ROBINS INC.

THE J. Stone Group

32 VICTORIA STREET, LONDON, S.W.1
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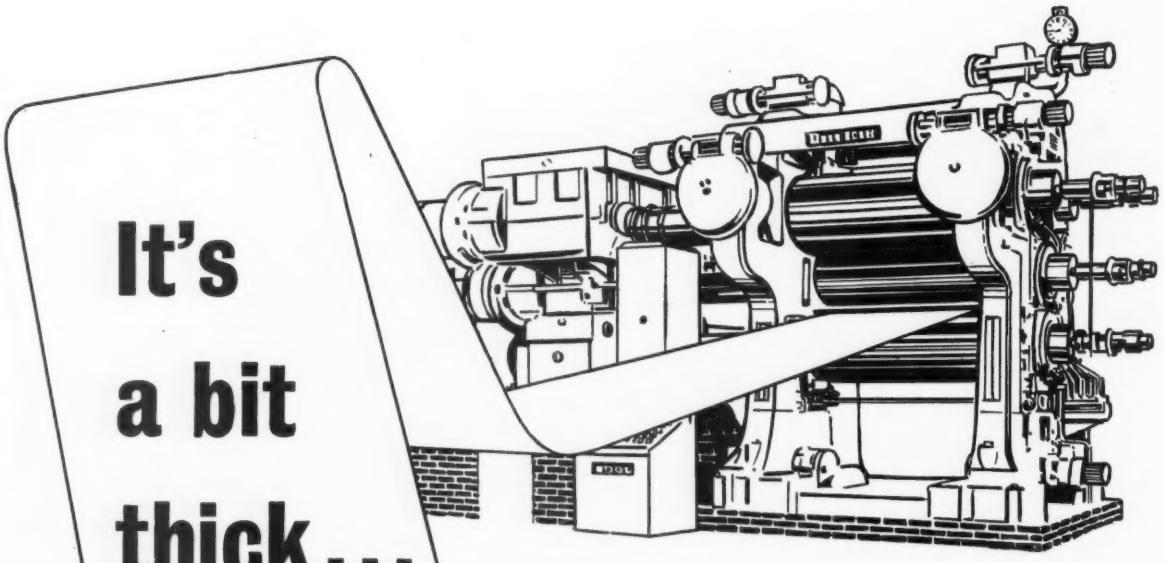
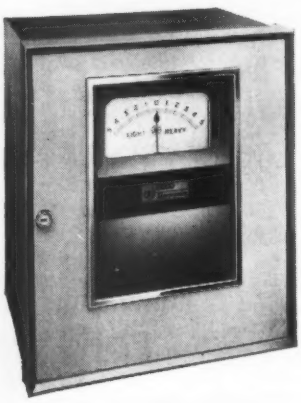


It's a bit thick...

if it is a plastic sheet and it IS a bit thick—or thin—the result is plain... Somebody is losing money

We have had very extensive experience in the development and production of thickness gauges and have supplied large installations to leading manufacturers in Great Britain, U.S.A. and throughout the world. The gauge illustrated below is a new instrument incorporating many outstanding features.



Without touching the flowing sheet the EKCO NUCLEONIC THICKNESS GAUGE eliminates test sampling by giving continuous indication of thickness: it provides immediate warning of variation: it reduces time taken in arriving at the correct thickness when starting up: accuracy is in order of 1% and it is suitable for measuring all plastic materials. The Ekco Nucleonic Thickness Gauge is a time and money saver to everyone who needs control over the thickness of continuous plastic sheet, and coatings of any type on plastic sheet. We shall be pleased to send you further details of the Ekco Nucleonic Thickness Gauges or our Technical representatives will be glad to call and discuss your requirements without obligation.

EKCO

nucleonic thickness gauges

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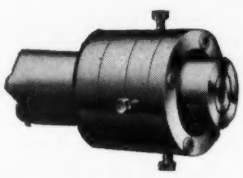
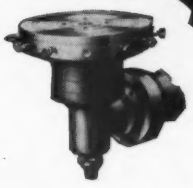
$1\frac{1}{2}'', 2\frac{1}{2}'', 3\frac{1}{2}'', 4\frac{1}{2}''$ Sizes

1½" plastic extruder with tubing die-head.

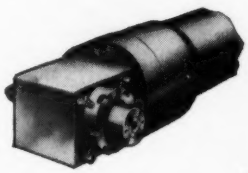


Tubing die-heads

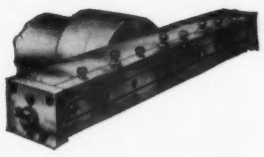


Lay-flat heads

Full range of auxiliary equipment available



Cross-heads for cables



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- ★ **Smooth vibrationless running**
- ★ **Screws and die-heads to suit duty**
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- ★ **Externally mounted variable-speed drive**
- ★ **Separate temperature control panel**

Die-head assemblies for piping, sheathing, sheeting, stranding, belting and lay-flat.

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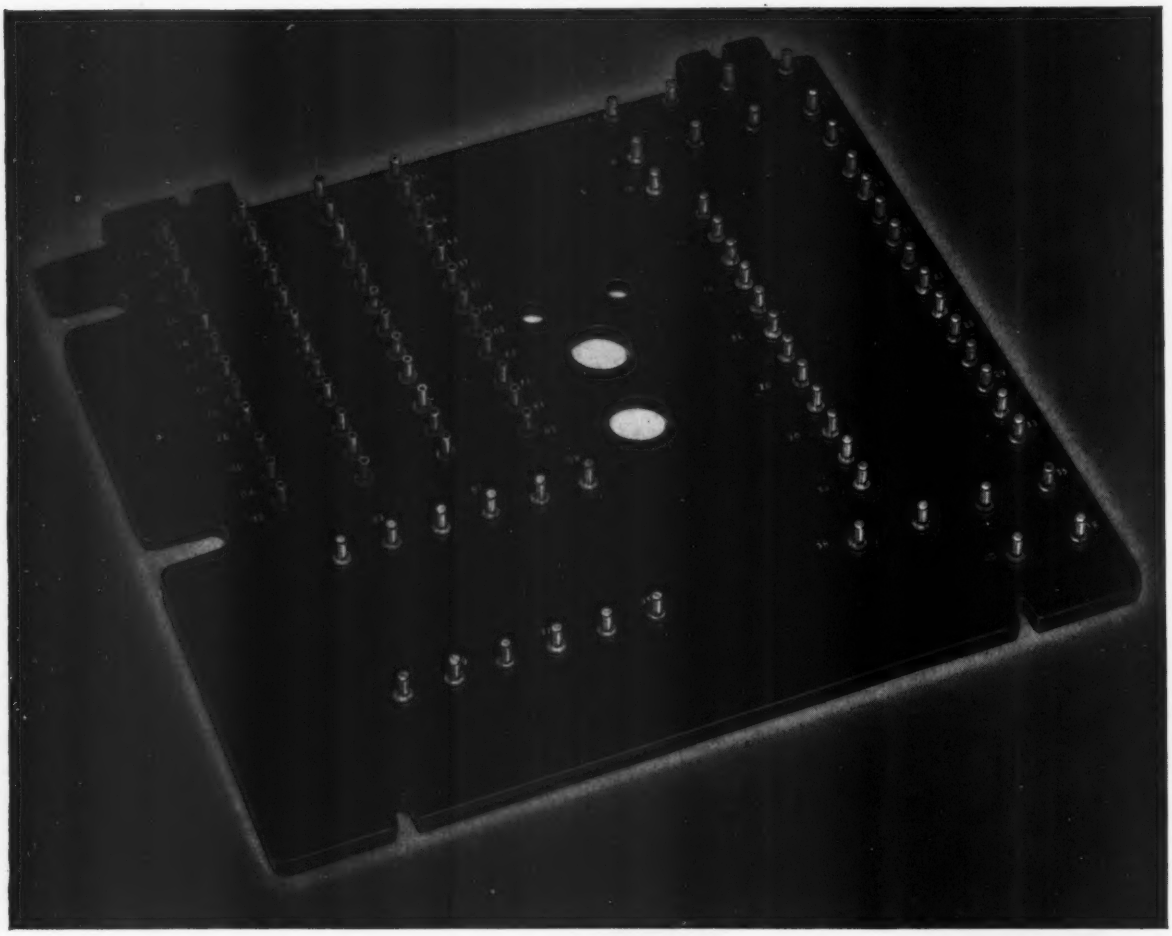
Represented in Australia, Austria, Denmark, France, Norway, Sweden, Yugoslavia.



HARDLY A ROUTINE MOULDING!

We regard this compression moulding as an achievement. It measured 12½ in. square and included 100 threaded inserts of two different types—a number of which were keyed by identification numbers. To say that it presented our toolmakers and moulders with many problems would be a masterpiece of understatement. Consider these facts. All inserts had to be placed accurately, at the correct height. No material was to foul the insert threads and their cadmium plated surface was not to be scratched or damaged during moulding. It was insisted that, as the mouldings were for electronic equipment, they should be completely homogeneous and no chalking between inserts was permitted. The mouldings have now been made and, from inspector's reports received, comply in every respect with the specification. If you require mouldings by compression or injection in which dimensional accuracy is essential we would be pleased to co-operate with you.

The moulding is a contact panel assembly for a card-sorting machine made by International Business Machines (United Kingdom) Ltd. A hundred separate ejectors, one placed below each insert, were employed. They had to be perfectly square to avoid distortion. Two radio-frequency heaters were employed to ensure absolute homogeneity during moulding.
Photograph by kind permission of International Business Machines (United Kingdom) Ltd.

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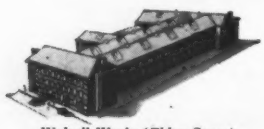
E. Elliott LIMITED
THE MOULDERS WITH THE ENGINEERING BACKGROUND



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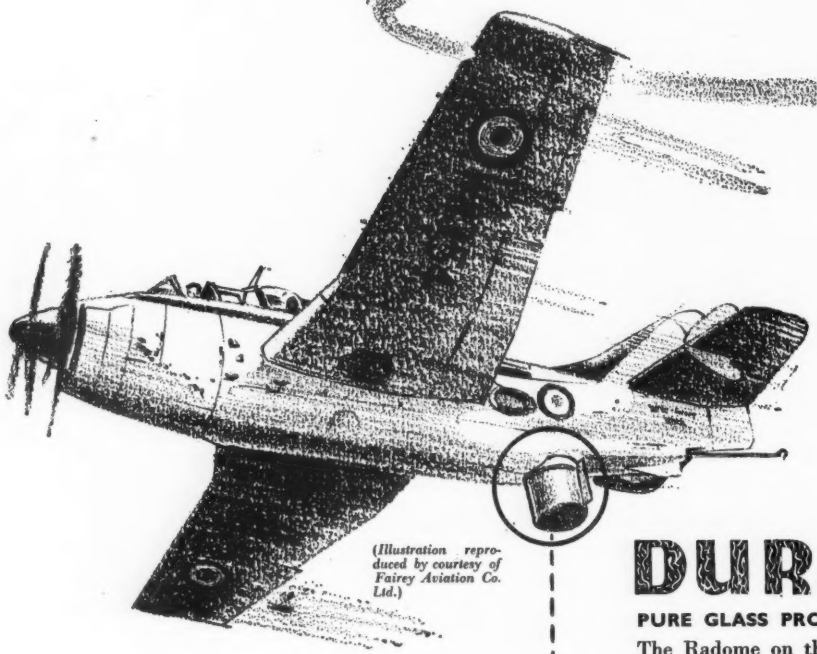
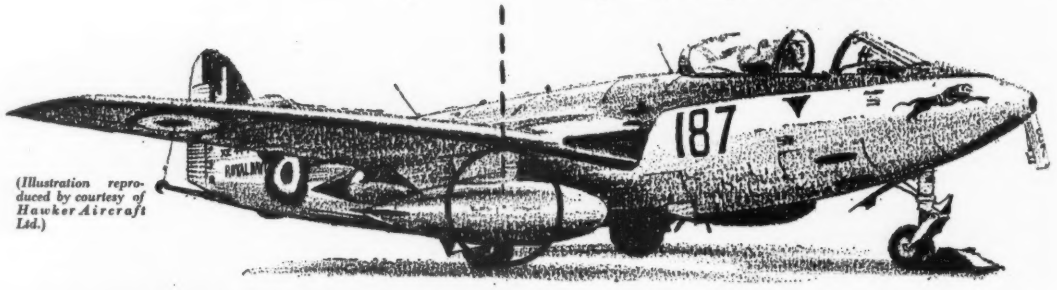


(Illustration reproduced by courtesy of Fairey Aviation Co. Ltd.)

DURAGLAS REGD

PURE GLASS PRODUCTS

The Radome on the Fairey Gannet A.S. Mk. 1. illustrated is of "Duraglas" glass fibre reinforced plastics construction giving a unit combining lightness, strength and durability.



(Illustration reproduced by courtesy of Hawker Aircraft Ltd.)

DURESTOS REGD

RESINATED ASBESTOS FELT & FLOCK MOULDING MATERIALS

The 75-gallon Plastic Drop Tanks on the Hawker Sea Hawk shown above, are moulded by the Bristol Aeroplane Co. Ltd. from high strength, light weight "Durestos". "Durestos" is released to A.I.D. requirements and is to date the only plastics material approved for use in the manufacture of Plastic Drop Tanks, which are classified as Class 1 Aircraft Structures.

TURNER BROTHERS ASBESTOS CO. LTD. ROCHDALE ENGLAND

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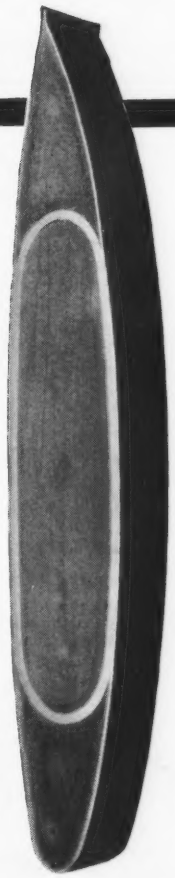
dmTA16

Going places in important spaces...

materials expanded by Genitrons



Filling the space in the tough steel shell of the Britannia's propellers — manufactured by de Havilland Propellers Ltd.— is a Genitron expanded material. A very special requirement this and the filling specified — a lightweight plastic which is rigid and cellular by virtue of a Genitron expanding agent — is equal to it.

But many other purposes are equally well served by Genitron expanded rubber or plastic materials. Rigid expanded plastics are used extensively in lifebuoys and fishing floats, for insulation, and as sealing strips and space fillers for the car and aircraft industries. Soft expanded materials are used for shoe soles, upholstery, packaging, toys, and for moulding. And the saving of raw materials — and of weight — is immense. Some plastics while still retaining high compressive strength can be expanded to a thousand per cent.

There's a lot more worth knowing about Genitron blowing agents. Why not contact us now for technical advice and detailed literature?

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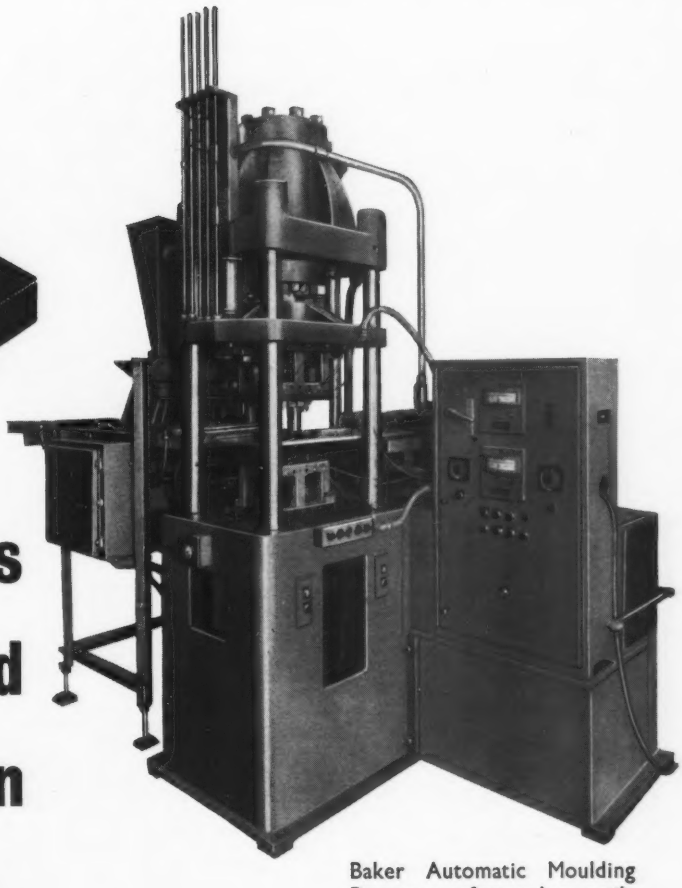

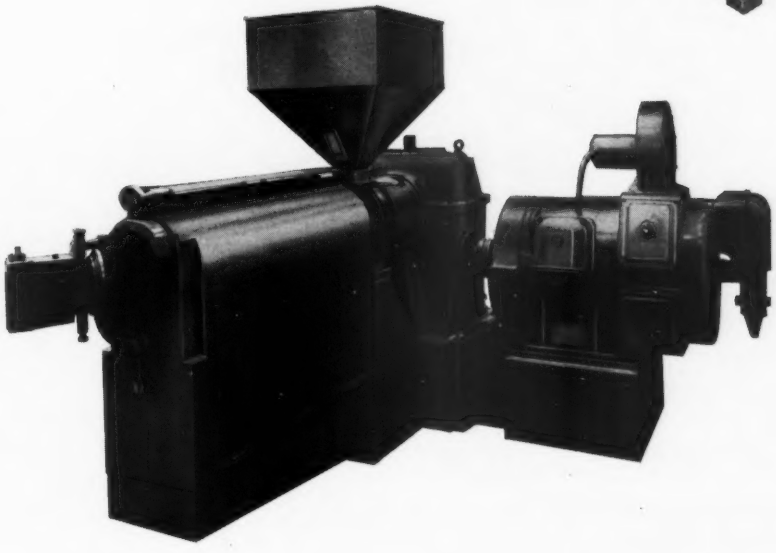

Baker Automatic Moulding Presses are fast and versatile machines for efficient automatic moulding. Models range from 15 to 100 tons.

"Davis-Standard" Thermoplastic Extruders offer an efficient and thoroughly dependable solution to all extrusion problems. Ancillary equipment includes heads and screws for all materials including sheeting and tubing production.
Fawcett-Finney also make capstans, take-ups, pay-offs, cooling troughs, shears and stacking units. Full details on request.

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Turner A.30. Body Shell by Hill's Fibre-glass Developments Ltd., using Cellobond Polyester Resins made by British Resin Products, Ltd.

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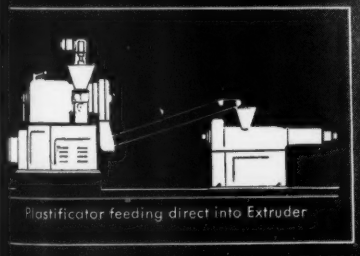

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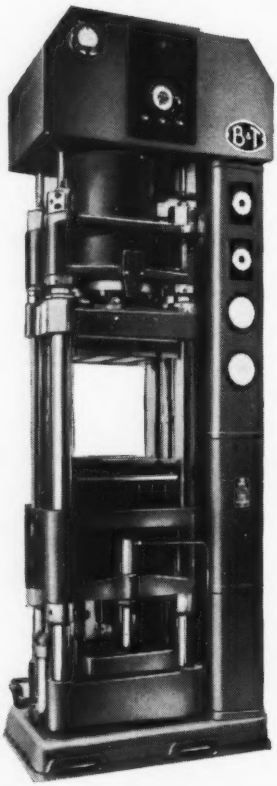
FOR THE PLASTICS INDUSTRY

Bristol's CDX 500 Automatic Process Cycle Controller has been selected by Messrs. Bradley & Turton Ltd., for controlling their No 536 U1 Hydraulic Moulding Press.

This Controller, the most advanced instrument of its type available, cuts to a minimum "down-time" of the process during changes of time cycle by providing easy access for camshaft adjustment. The cure period, controlled by a separate timer, is continuously variable by finger-tip adjustment of the knob mounted on the front of the instrument.



Photograph by courtesy of Messrs. Bradley & Turton Ltd.

Bristol's Model CDX 500 Cycle Controller.

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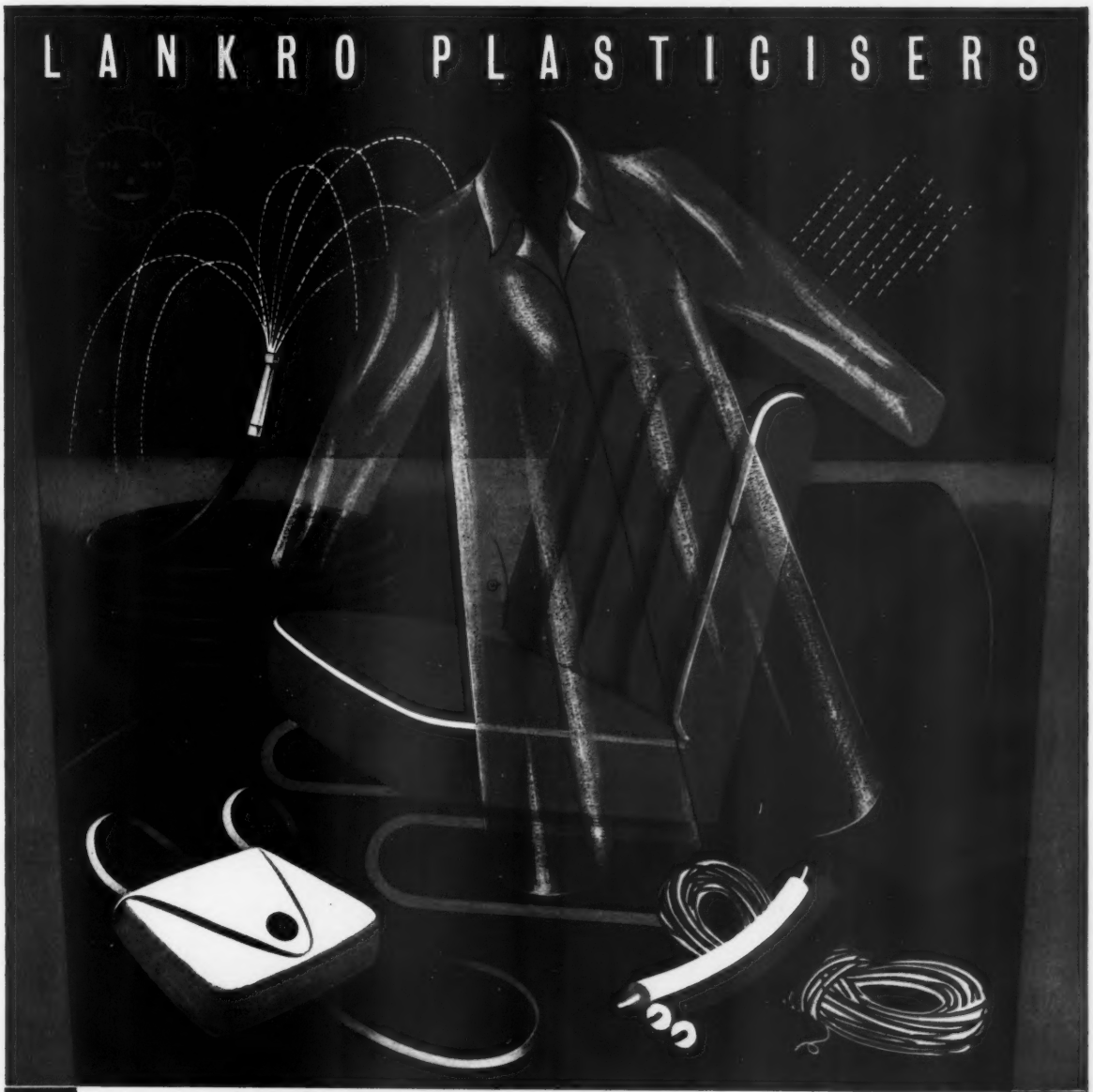

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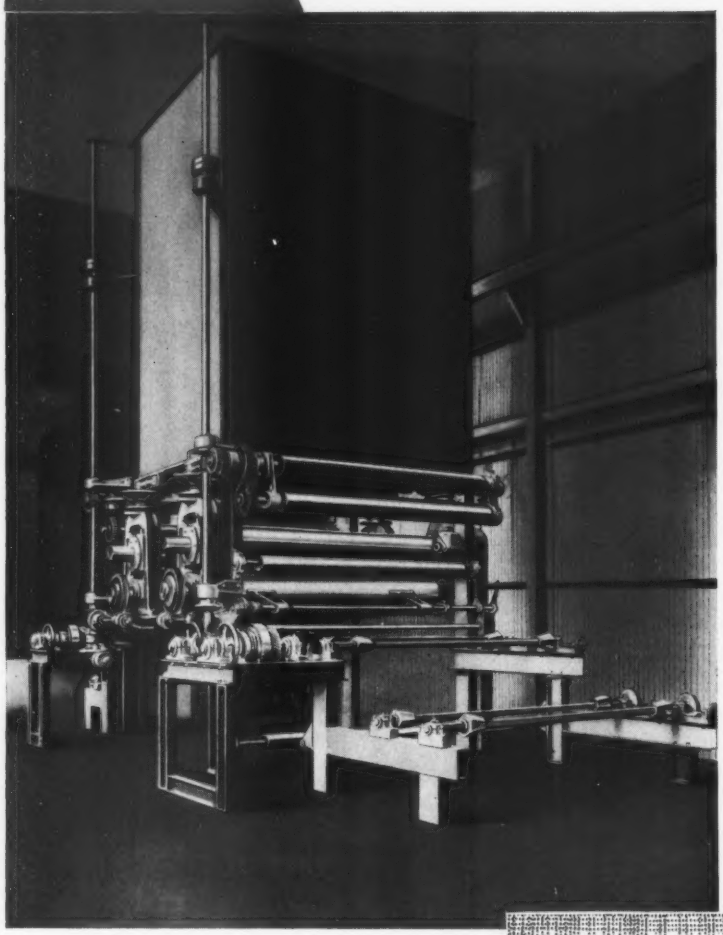

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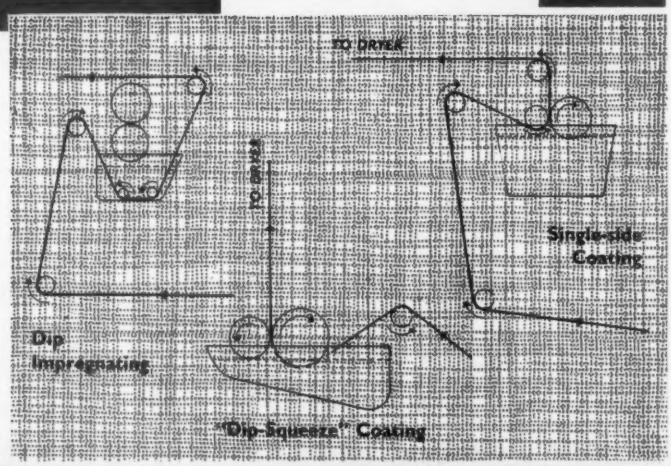

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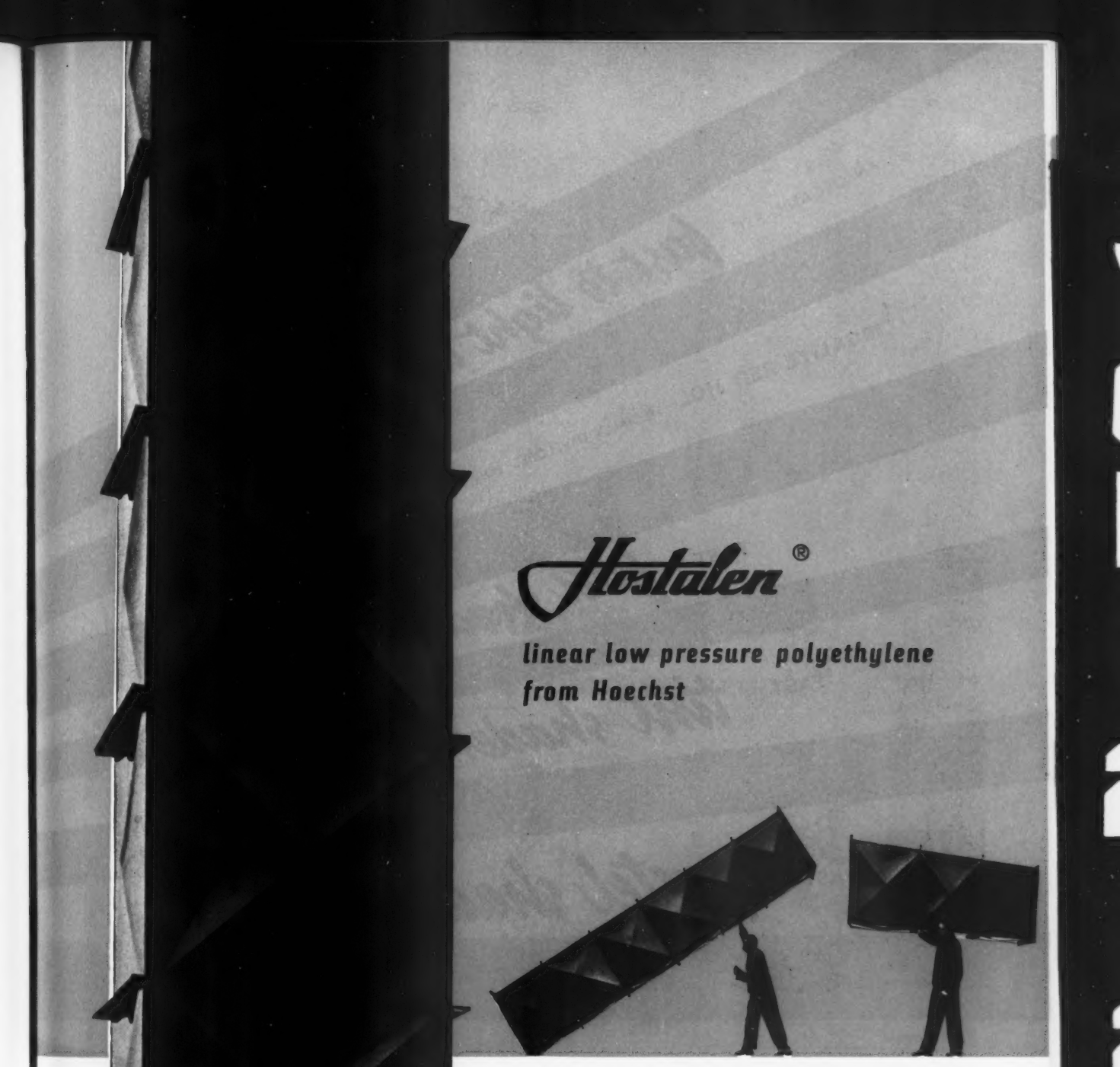

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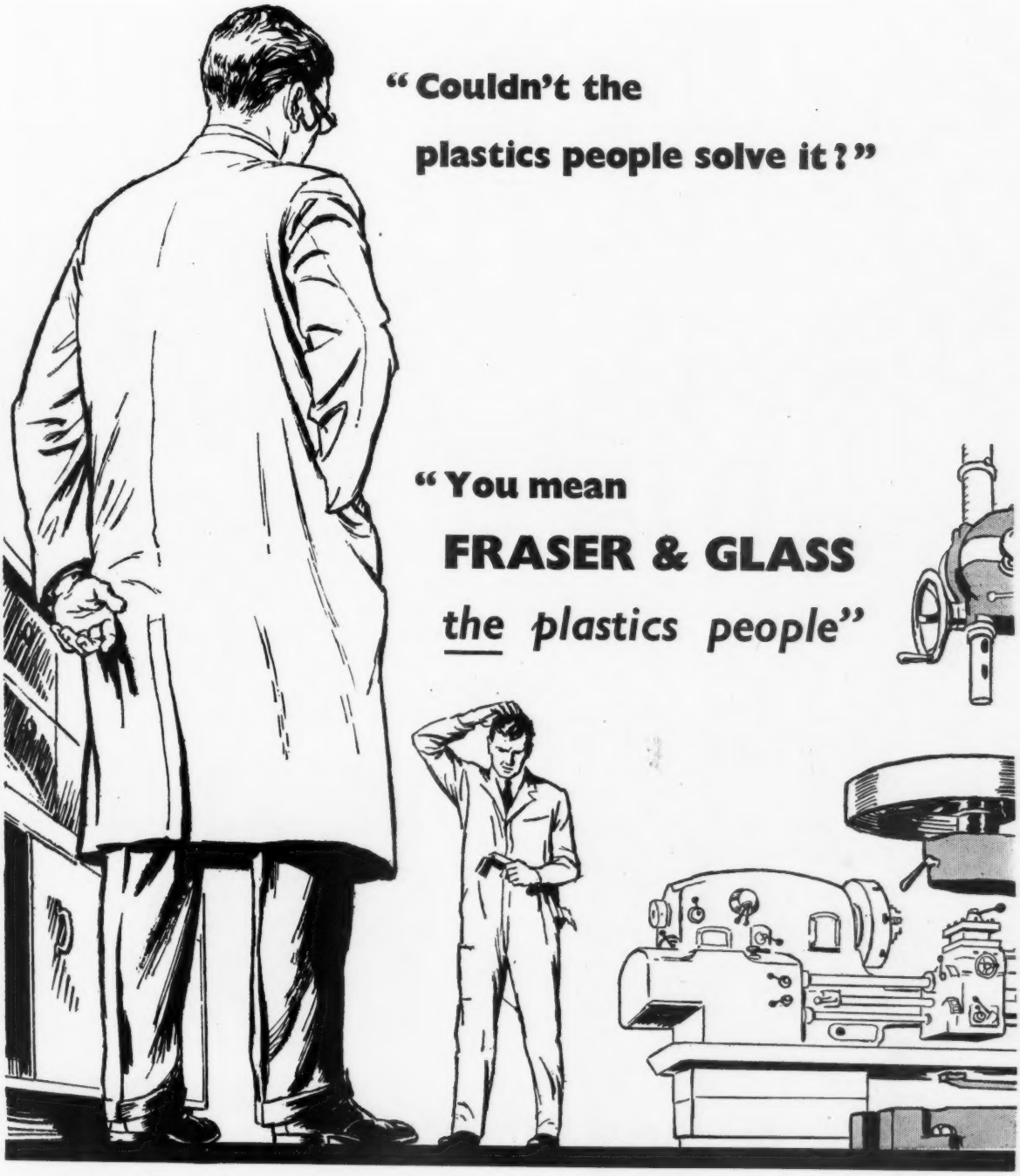

Whether your problem is an intricate high precision component which has to resist heat, corrosives, shock loads, electrical discharges and the rest, or a display pack which simply needs to look attractive—a plastic moulding may be the answer. And if plastics can help, Fraser & Glass are the people to see. They have the know-how on plastics materials and the facilities for high speed injection and compression moulding, together with the skill to ensure success. During the last 30 years, Fraser & Glass have solved countless manufacturing problems and often, they've saved manufacturer's money! If you've a problem where you think plastics might help, *ask Fraser & Glass!*

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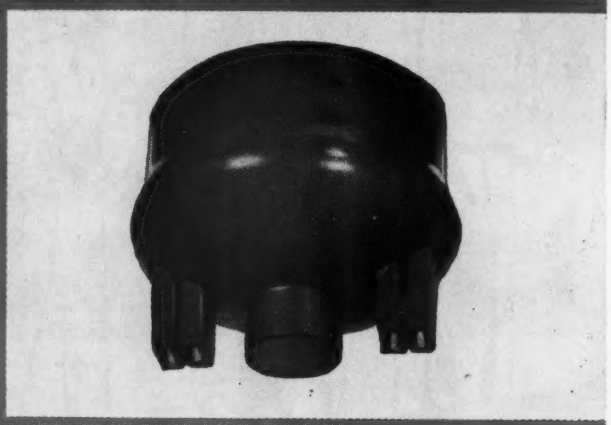

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—material progress

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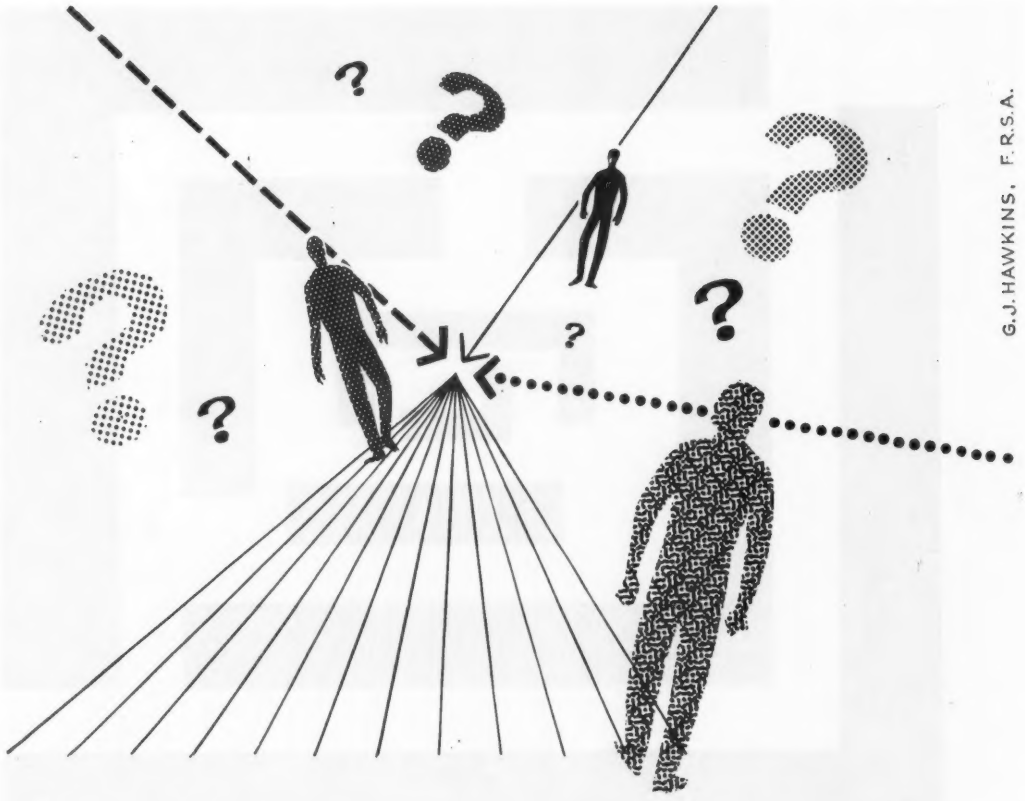

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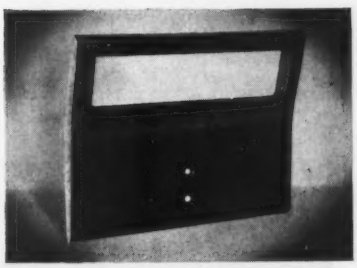
Special grades of "Sternite" have been developed to meet the most exacting requirements demanded for the moulding of heater and radio cabinets; in particular, ease of moulding, perfect finish, mechanical strength and dimensional stability under the most severe service conditions.



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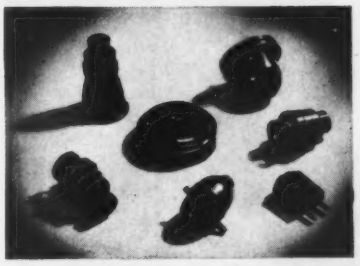

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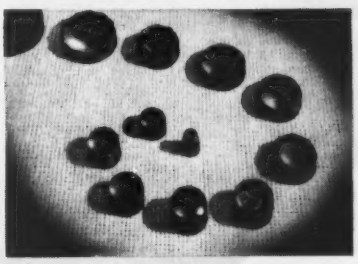

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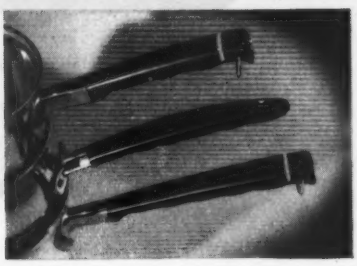

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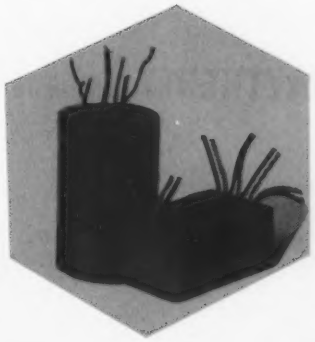

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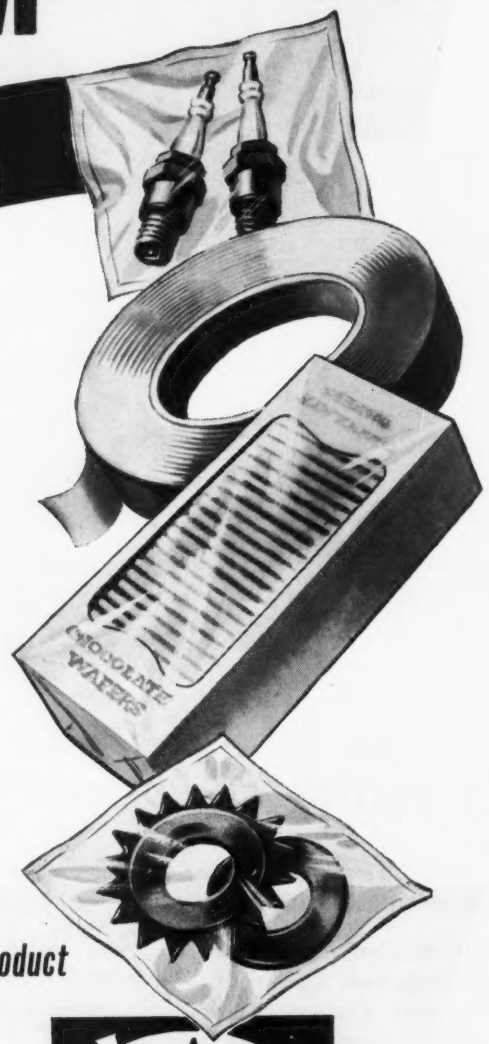

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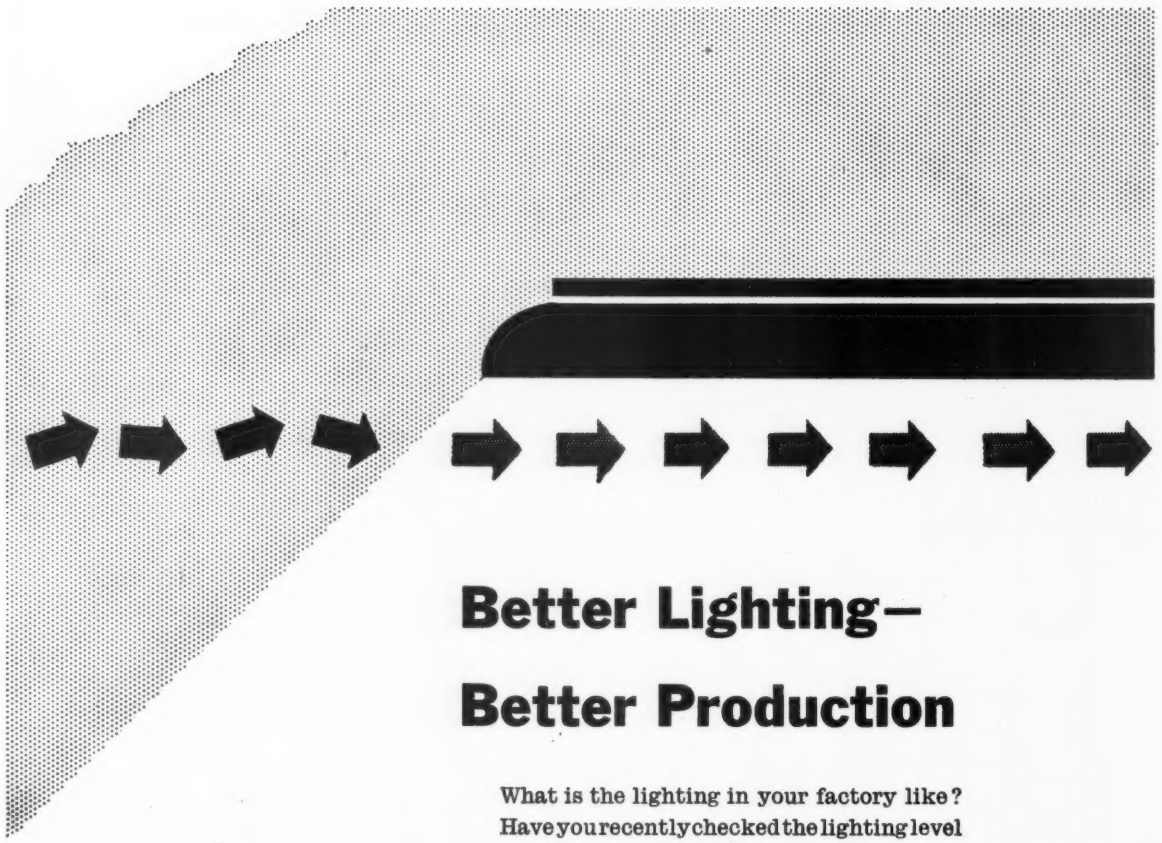

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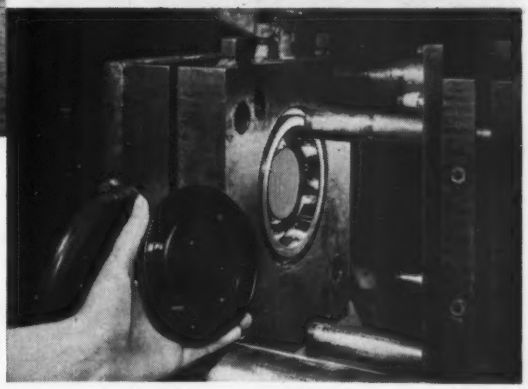

Streetly moulds the four pieces shown above, the bases (Polystyrene), inkbasket (Polythene), lid closure (Bakelite), and pen taper (Polystyrene or Diakon). The pen tapers have to be moulded to optical standards to avoid blemishes which would be magnified in the mouldings. At right is shown the single impression mould and one of the moulded bases.

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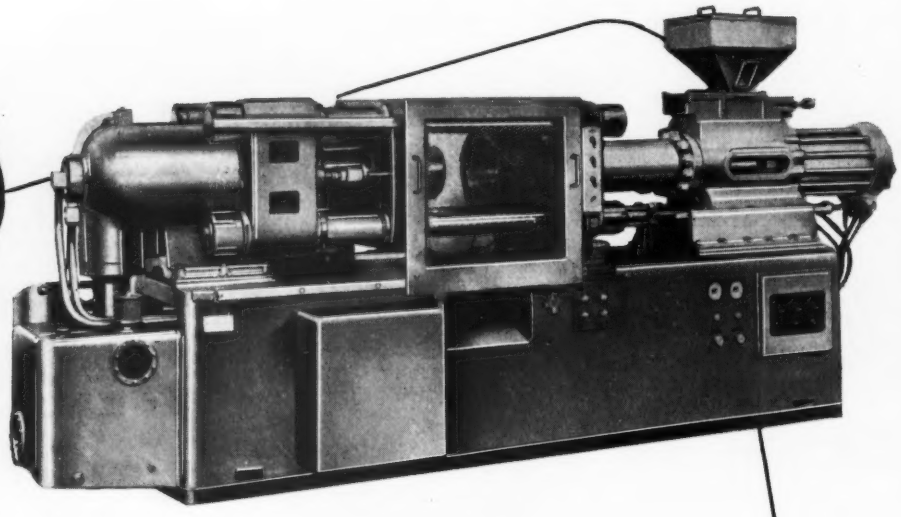

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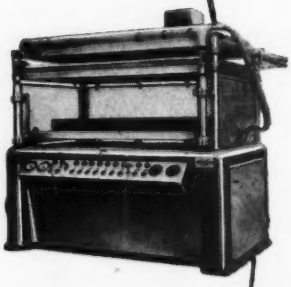

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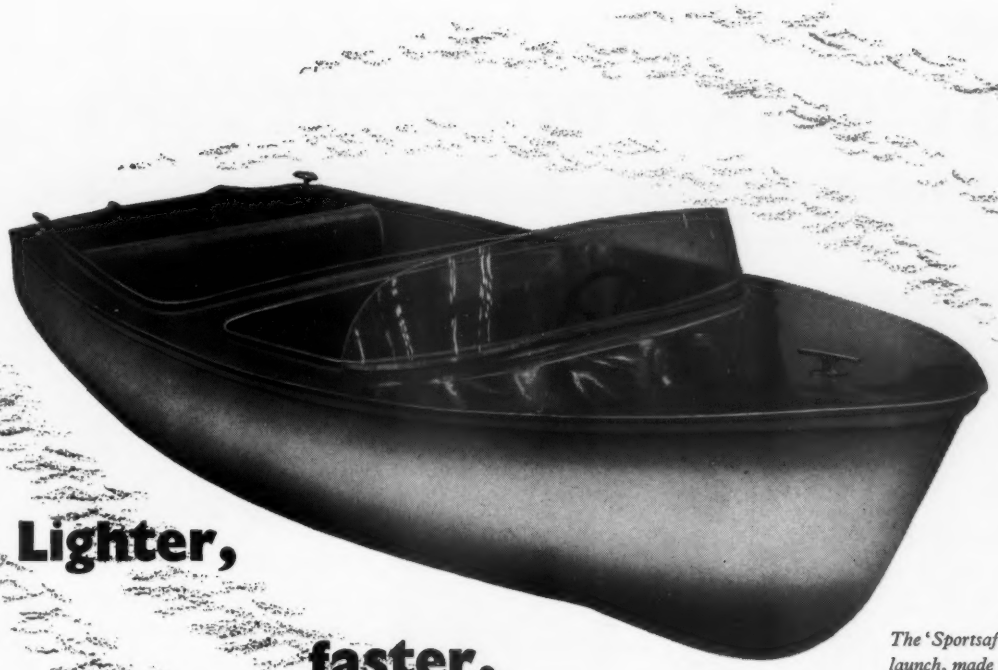

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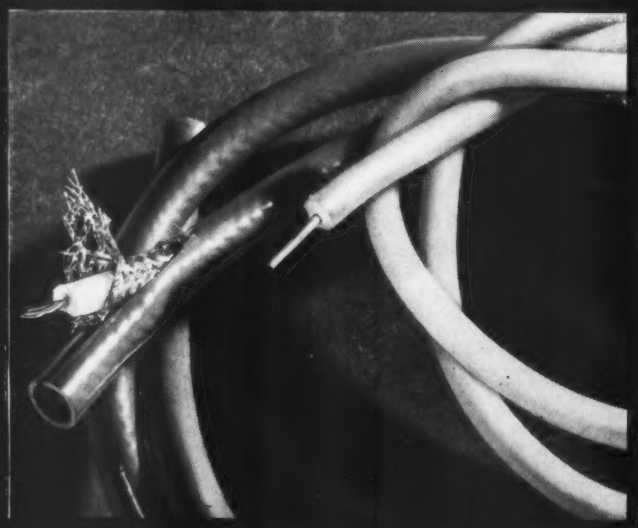

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Plastics

DEALING WITH THE MANUFACTURE, USES AND POTENTIALITIES OF PLASTIC MATERIALS

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EDITOR: M. D. CURWEN, B.Sc., A.R.I.C.
ASSISTANT EDITOR: C. W. WELCH

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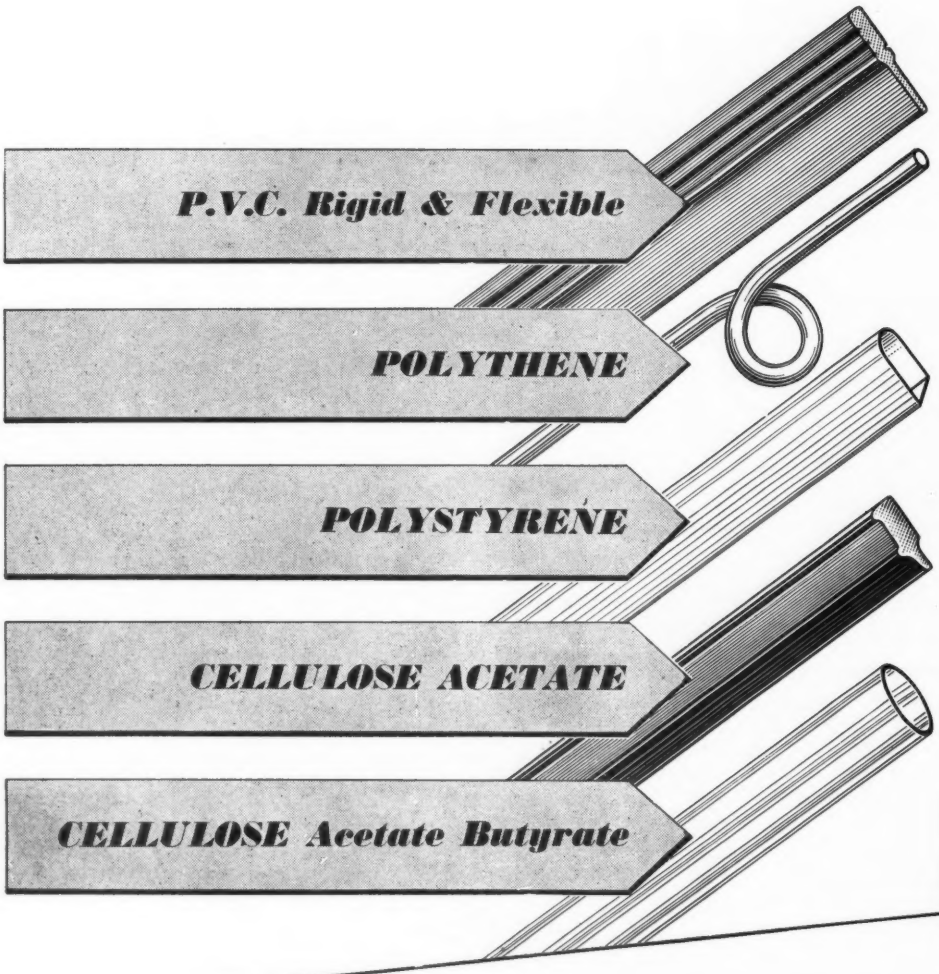
Ageneral view of the main assembly shop at the Higham's Park factory of Halex

NP48



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Plastics

VOL. XXII No. 233 FEBRUARY, 1957

EDITORIALS

Real Progress in Resin/Glass Technology

IT is our extreme pleasure this month to convey a piece of information that has heartened us more than any other since we began watching the glass fibre/resin structure scene more than ten years ago.

Those who are occupied in this field will doubtless remember the important paper delivered by Mr. John Rees of the Bristol Aircraft Co. Ltd. at the British Plastics Convention in 1955 in which he described a new process of producing such structures by injecting polyester resins under pressure into glass fabric held within a mould.

Last month we were privileged by Mr. H. J. Pollard, Director and Chief Development Engineer of the company, to see the latest developments in this process which have advanced to what might be called an automatic pilot plant stage. Great in conception, brilliant in design and execution, even in this early form, it lifts the whole technical practice of reinforcement manufacture to a gratifying high level. We are approaching the production of high-duty engineering structures rapidly and mass production at this same time.

This is not all. During the past year or so an intense study on the physical properties of both glass fibres and resins has been carried out and is continuing at Filton by Mr. W. A. Baker and his staff and a point has been reached at which certain specifications for the most suitable glass fibre and resins (so far as can at present be estimated) have been drawn up. Collaboration with the raw material manufacturers is now in progress to attain these ends, and also to raise considerably the value of Young's modulus of glass-fibre laminates. Bristol's have good grounds for believing this to be possible, though successful outcome may be somewhat long dated. The effect on aircraft structure could well be revolutionary.

We hope to describe their work at Bristol Aircraft Co. Ltd. in a future issue of *Plastics*.

Bucket and Brush Technique

LET us turn now to a less heartening aspect of the reinforced plastics industry—the wet lay-up process using chopped glass fibre in short lengths and their impregnation by the brush and roller method. Most of our readers will know that we have taken an uncompromising attitude as to its value.

We state that the process is crude and inefficient and cannot in its present form, result in a material built to specification and therefore cannot be fit for " high-duty " engineering schemes. No piece can be consistent in characteristics throughout its area or thickness. It is impossible to produce an identical twin or to approach it closely.

The claim that " good and strong " structures have been made can be substantiated, but only in a general non-technical way which cannot impress the engineer. Moreover we should require more evidence than is available at present, to believe that a firm making " good and strong " structures produces them consistently and without its quota of failures.

Let it be quite clear that we are not always aiming at perfection. We know the importance of " lower-duty " jobs—we do not use stainless steel where mild steel is adequate nor $\frac{1}{8}$-in. aluminium sheet where $\frac{1}{16}$ in. is appropriate; we know also the importance of short runs, but each and all must be made to reasonably rigid specifications. Metal sheet is rarely degraded to an important extent because of work-hardening, by panel beating. What appears to be bad work in metal sheet is often due solely to fillers introduced during the finishing stage. At least the work starts off on the right foot—with a sheet made to specification.

Basically the fault lies not in the chopped glass fibre as such, nor indeed with the resins. It is clearly the method of using them that is at fault. It is an anachronism in a world and age that talks glibly of the new physics and new chemistry, of electronics and automation. In a world of growing mass production we employ a process from which mass production cannot emerge. In a world where short runs will always be essential and which so often signifies the highest quality, we cannot give it.

It may be thought that we regret the coming of chopped glass fibre. This is not so as yet—but let us look back into its history. The glass fibre fabrics universally used originally, are at least of coherent and " manageable " structure, close enough to being engineering structures themselves to enable the production of many jobs of high merit even with the impregnation difficulties introduced by the brush and bucket method. They can, as we have seen, form the basis of mass production. To high-light this difference we may add here that while many structures based on glass fabric have long been produced for the Ministry of Supply, we know of none made by the wet lay-up process using chopped fibre that is as yet acceptable to that Ministry for consideration on a production level.

The chopped fibre wet lay-up process was derived simply and clearly from the fact that the use of fabric resulted in more costly products than those made from conventional materials such as metal. The chopped fibre was offered as a cheaper substitute. Inevitably, since other possibilities were not considered or were rejected, the brush and bucket method was also employed, because, so the proposed user was told, the process was simple and that cheap moulds and unskilled workers could produce high quality high strength structures. Few realised also the simple fact that we were asking users to make their own raw materials for the first time in history. Almost all were silent instead of disclosing the plain fact that for reasonable-sized production, the plant must be laid out, with certain sections segregated, as a factory liable to industrial hazards, and that the mixing and hardening of the resin must be carried out as a chemical operation, which it certainly is.

Thus far, say our critics, we are merely destructively critical, as if that in itself were an evil thing What do we say, they add, other than to hint at throwing the whole system into the discard?

This is simply not the truth. We believe that chopped strand can still be employed as a useful basis. We believe that the great weakness of the existing process is that good wetting of the glass or adhesion between it and resin and reasonable freedom from voids cannot be achieved thereby. Moreover its loose structure, so different from that of fabric, lends itself so readily to distortion and to the creation of weaknesses. We believe that better results can be achieved by mixture of the glass and resin *before* it reaches the mould, and that if such a mixture, reasonably fluid in consistency, were possible, then it

could be spread by mechanical means, such as a series of " jig-spreaders " shaped to the curvatures of the mould and moving on them. Thus some semblance to uniformity both in glass/resin content and thickness could be obtained for a large number of jobs, at greater speed and possibly with less labour. This would, perhaps, produce no " high-duty " job, but it could not be so varied in character as one produced by the present method.

Obviously the mixing process would be difficult, but much might be done by treating the glass with a dewatering agent leaving behind a fine film of residue more receptive of the resin. Alternatively it may be possible first to coat the glass with a thin film of varnish with reasonable affinity both for glass and the resin, a " know-how " often applied in other fields. Mixing might suitably be carried out *in vacuo*.

We are sure such a process can be devised. Impregnation should not be left to take place on the mould by hand.

Low Pressure Polythene

WE were invited last month to meet Dr. von Klenck, Technical Director of Farbwerke Hoechst A.G., at the offices of Hoechst Chemicals Ltd., to hear about progress in the development of low pressure polythene for water piping. He began by pointing out that regulations made by German municipal and other undertakings are more severe even than in Britain. A supplier of piping, for example, is required to give a guarantee that it will give satisfactory service for a period of up to 50 years. For this reason, polythene has so far made comparatively little impact upon the German market.

The majority of service experience with polythene piping has therefore been obtained in Germany by the raw material manufacturers themselves. Farbwerke Hoechst have installed 18 miles of Hostalen polythene pipe in their own plant, the only failure occurring when live steam was accidentally introduced into a section of the line. From this experience, certain conclusions have been made by the company's technical staff, the most important of which is that low pressure polythene should not be used for piping where the temperature will be above 45°C. Even this must be regarded as the absolute maximum.

Given this limitation to cold water services, the company is now about to introduce a new grade of Hostalen which is expected to meet the rigid requirements of the German building industry and municipal authorities. This material, Hostalen GM 5010, has a higher molecular weight, without sacrificing the good processing qualities of the previous grade, Hostalen G.F.I.

Dr. von Klenck also answered questions on stress cracking, catalytic contamination, and degree of crystallinity. In connection with stress cracking, he pointed out that Hostalen is no more subject to this phenomena than any other material. In particular, the degree of crystallinity, which is higher in low pressure polythene than in the high pressure type, due to the predominantly linear structure, is not the cause of stress cracking if and when it occurs. In the matter of catalytic contamination, the ash determination shows a value of 0.01%, and this low value comprises inactive oxides.

From the foregoing notes one fact emerges which throws an entirely new light on the situation; low pressure polythene, at least for water piping, is not yet at the point where hot water services can be envisaged.

MOULDING POWDER AND SHOT

From the Horse's Mouth.

This issue, I see, devotes quite a bit of space on glass-fibre/resin reinforcements. Oh, dear ! I had other important things to deal with but I must say this. Some readers may know that the Editor, who apparently has his own ideas on the subject, recently wrote a paper given before the Institute of Road Transport Engineers. It seems to have raised a bit of a stink in some quarters. One bit of this stink is from the Editor of *Bus and Coach*, a monthly journal in the field of public transport (neither he nor his representative were present). He gives vent to his righteous indignation from the unplumbed depth of his knowledge on the subject in a recent editorial: " What can only be described as an attack on the potentialities of glass-fibre reinforced resin plastics in body-building was launched last month before a London meeting of the Institute of Road Engineers. The attack formed the outstanding feature of a paper whose authors hold positions entitling them to be regarded as experts on their subjects . . . . If taken seriously their criticisms will have the effect of retarding development of materials for which there is every reason to believe the future holds greater promise . . . The authors refute that the manufacture of shaped body panels from glass-fibre and polyester resins can be conducted without expensive plant, especially equipped premises and highly paid labour. In fact it is largely due to none of these things being essential, coupled with the light weight and durability of the finished product which has so encouraged operators to go ahead . . . " Nobody refutes that car bodies and panels are being made by the wet lay-up mat process; I have indeed seen many of them, but the presumption that high-duty or even that completely consistent " medium duty " jobs can be produced simply cannot be upheld. It is unfortunate that the writer appears to have no knowledge of process analysis and lay-out of plant necessary for such a process. That he considers no skilled workers are necessary nor especially equipped premises is, to put it mildly, astonishing. I would direct the attention of the Editor of *Bus and Coach* (which for all I know is a direct successor of *Sedan Chair, Horse-Bus and Coach*, a rattling good paper when I was a boy in 1840) to Mr. McCullough's article on page 51 of this issue. Perhaps he will consider such an organized factory quite unnecessary and a waste of money. I consider it a sign of strength and confidence.

* * *

Down with Mottles!

I've always wondered why mottled colours in plastics are decried by artists. Not that I've liked them myself in the past but I've wondered how much intrinsic value goes increasingly into a decision of this sort even among artists. I well remember seeing the malachite doors framed in solid gold in the Mexico City National Museum and often wonder how much of the beauty of the green and black confluents of the malachite is due to rarity and the observers knowledge that it is a semi-precious stone, or is it because it conjures up the terrifying forces of nature that made the malachite millions of years ago. I know it isn't very exciting to remember that some mottled plastics are made merely to incorporate " left-overs " of different colour into a moulding and so to save money, but others in celluloid and casein to simulate tortoiseshell seemed no less beautiful to one than real tortoiseshell. Probably not to the tortoiseshell expert, but why should he set up as an æsthete merely because he knows from experience which is genuine and which is not ? I think white marble beautiful, but on the other hand I dislike intensely veined, mottled marble especially when nature makes the mottle with gingery-coloured iron oxide.

* * *

Up with Mottles!

I'm intrigued in all this, because while in Stockholm I was interested to hear from somebody who ought to know, that " mottled design will be seen again—this time in a very advanced and acceptable form." It was only a few weeks after getting this information that I think I saw the very thing he meant at the splendid plastics exhibition in Paris last November. On a composite stand put up by the Canadian plastics industry were some examples of melamine household ware—cups, saucers, plates, etc.—made from Canadian Melmac. All the specimens shown were mottled but of such delicately mingled pastel shades of grey, blues and yellows that the general effect was one of a beautifully hand-stippled enamel.

DOGSBODDY.

In this article we describe one of the major developments in the injection moulding sphere in recent years. An account is given of the design and production considerations involved in the moulding of street lighting fittings in acrylic material at the Higham's Park factory of Halex

Production Story

An arterial road in Romford; photo courtesy Thorn Electrical Industries Ltd.

STREET LIGHTING was the subject of two recent articles in the July, 1956, issue of *Plastics*. One described the fabrication of Perspex by Thermo-Plastics Ltd., whilst the other reviewed the part played by acrylics generally in this important field of application. In the course of the latter article Mr. P. H. Collins, of I.C.I.'s Plastics Division, described briefly the part played by injection moulded Diakon.

This article may therefore be considered in logical sequence to those published last year, since it sets out to describe the development of a most interesting injection moulding project by Halex–a division of the British Xylonite Co., Ltd. A number of mouldings are involved, all of which fall into the category of street lighting. First of all there is the large sodium lantern for class "A" roads. The others include smaller type lanterns for group " B " roads.

Collaboration in Industry

This article is of special interest, since it demonstrates the importance of close collaboration between the raw material manufacturer, the moulder, the toolmaker and the customer. As a result, each side of the industry pooled their knowledge and skill to solve the many problems which arose in meeting the customer's requirements. The result is a series of Diakon lanterns depicting the art of injection moulding at its best.

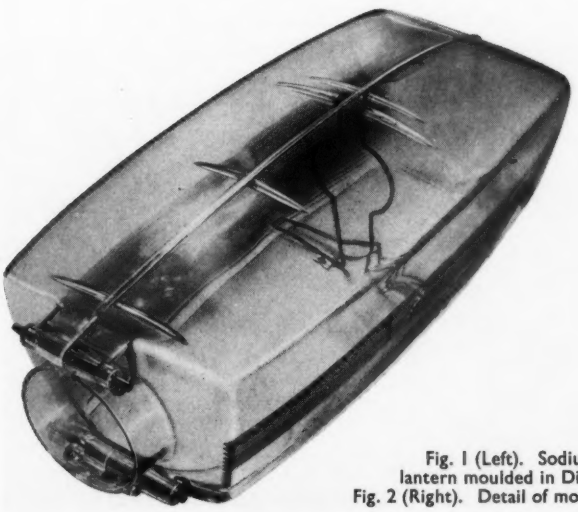
Two and a half years ago the Industrial Division of Halex began preparatory work with Thorn Electrical Industries Ltd. on a revolutionary type of sodium lantern. By working closely together a design was agreed which embodies the following requirements:—

(1) Pleasing appearance.
(2) A practicable tooling and moulding proposition.
(3) A sealed-in unit suitable for outside use.
(4) Ability to withstand the temperatures involved.
(5) Precise optical characteristics.
(6) Weathering resistance.

It is important to note here that the original conception was based on the principle that injection moulding was to be used to manufacture the lantern, and that the prisms were to be incorporated into the stressed structure of the lantern.

Early research was carried out by the Plastics Division of I.C.I. Ltd., at Welwyn Garden City, from whom a good deal of advice was obtained. The Diakon specialists were set a series of tough problems. Initially the specific grade of Diakon capable of withstanding the higher temperatures was found difficult to mould, particularly with large projected areas. This was modified to improve the flow of the material, still maintaining the temperature resistance required.

Fig. 1 shows a sodium lantern, which in use is suspended from a mounting bracket and exposed to all weathers. Fig. 2 shows the complicated changes of section at the mounting end of the lantern and the ingenious design of the bosses to house



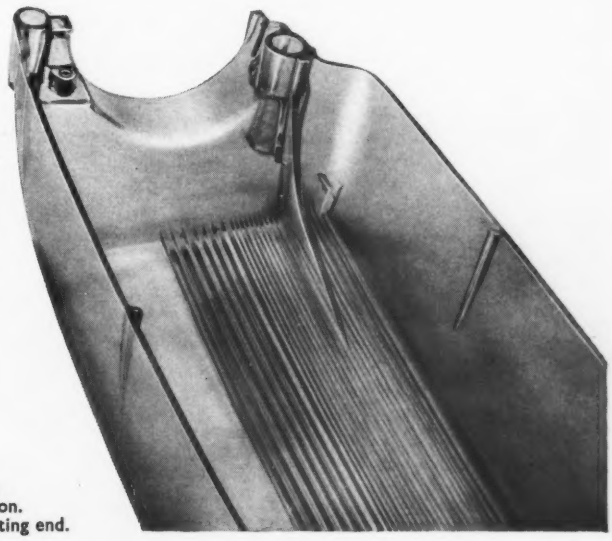


Fig. 1 (Left). Sodium lantern moulded in Diakon.
Fig. 2 (Right). Detail of mounting end.

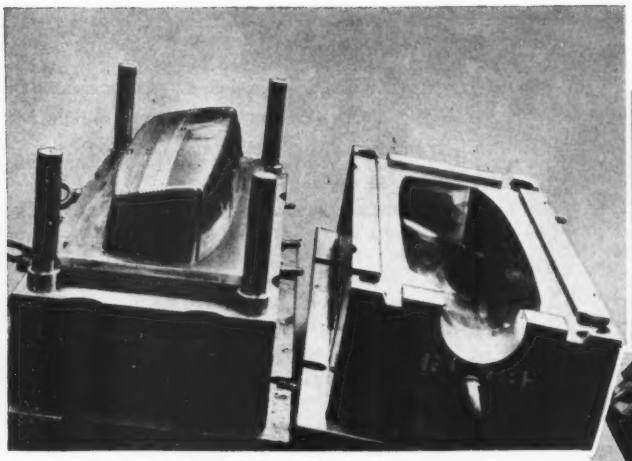
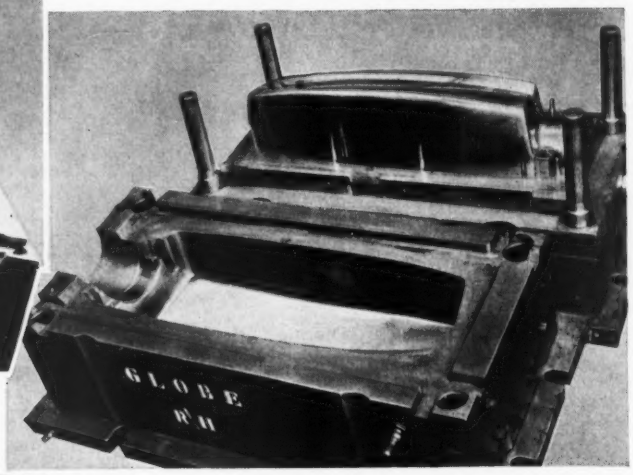


Fig. 3 (Above). End view of tool, showing prisms.

Fig. 4 (Below). Alternative view of Fig. 3.



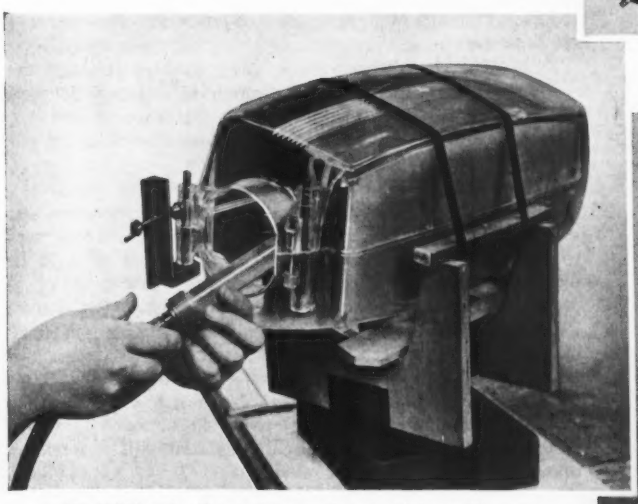
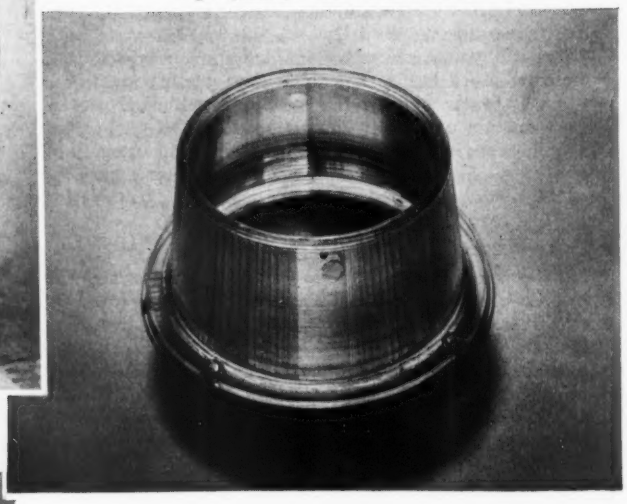


Fig. 5 (Above). Cementing together two halves of lantern.

Fig. 6 (Below). The Wardle lantern.



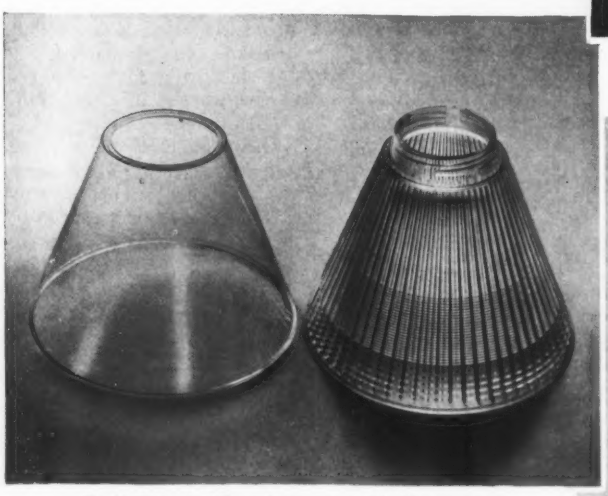
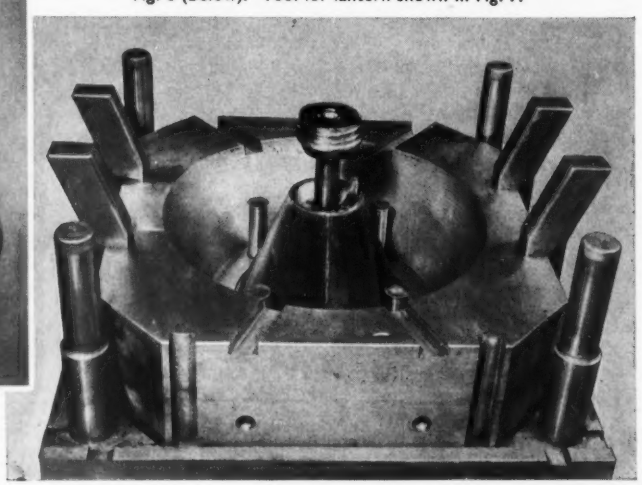


Fig. 7 (Above). Thorn lantern, moulded in two parts.

Fig. 8 (Below). Tool for lantern shown in Fig. 7.



the mounting rods. On a large moulding of this type it is important to avoid stresses in the moulding since these would immediately result in warping, and probably also prejudice the temperature characteristics.

A feature of the design is the moulded-in prism system. The prisms are housed on the inside of the unit, thereby effecting economy of maintenance from the cleaning point of view. These prisms are clearly seen in the tool shown in Fig. 3. An alternative view of the tool is seen in Fig. 4.

C.V.A. Tools, Brighton, made the tools, and these were completed in time for samples to be shown at the Association of Public Lighting Engineers Conference at Folkestone, in September, 1955.

The two separate halves of the moulding are ultimately assembled complete with the following parts:—

(1) An aluminium reflector, including lamp support.
(2) Two mounting rods, four brass inserts and two metal spring clips. Both halves are then cemented together to provide a sealed unit.

It will readily be appreciated that the cementing of the two halves created many difficult problems. In the first place, these must be free from warpage and fit together accurately. Furthermore the cementing must be such as to effect a complete gap seal, so as to avoid the ingress of dirt and moisture in the atmosphere. Finally, the cement itself must be capable of standing up to the rigorous out of doors conditions involved. This cement is polymerized by the use of a specially designed ultra-violet lamp tunnel.

From the injection moulding point of view the large projected areas represented by these lanterns raise difficulties in the accurate control of wall thickness. A very careful watch on moulding temperatures and pressures is essential. Practice shows that these cycling conditions are critical in avoiding the setting-up of strain in the mouldings, of special importance when cement is applied in the final assembly stage.

The cementing operation itself raises problems, and many types were tried. The normal No. 6 cement does not possess gap-sealing properties, which are essential. Secondly, this grade is unsuitable from the weathering point of view. No. 3 Dough Cement, chemically catalyzed, was tried, but the very limited pot life did not lend itself to production conditions, and did not give a sufficiently neat joint. Research by I.C.I. and Halex technicians produced a solution to this problem by using No. 3 Dough Type Cement and polymerizing this in a specially designed tunnel fitted with U.V. lamps.

Fig. 5 shows assembly on a rotating wooden jig, the two halves being cemented together with the aid of a pressurized gun loaded with No. 3 Cement.

Group " B " Lighting

Shortly after the commencement of work on the Sodium Lanterns plans were put in hand for moulding Group " B " lanterns for the Wardle Engineering Co., and also a differently styled Group " B " lantern for Thorn Electrical Industries Ltd. The two lanterns in production are shown here. Fig. 6 shows the Wardle lantern, the prisms for which were designed in co-operation with I.C.I., and in Fig. 7 the Thorn lantern is shown in two halves, the inner carrying prism forms, and the outer, which is merely a clear cover.

The Thorn lantern carries vertical prism forms on the inside, whereas the horizontal prisms are incorporated in the outer face. An internal thread is moulded in the neck. (See Fig. 8.)

A good deal of thought was put into the tool design. The horizontal prism form is, of course, carried by the dies which open on a cam system. The thread moulded in the neck had to be so designed that the core unscrews from the underside in the direction of the open end of the moulding, at the same time enabling the aluminium top cap to screw in from the other side. The location of the thread is critical, since when the top cap is screwed fully home the spring contained within the top cap engages with a moulded-in slot in the neck of the lantern. This position is critical, since it lines up with the prism form designed to beam the light in certain directions and diffuse it in the face of oncoming traffic.

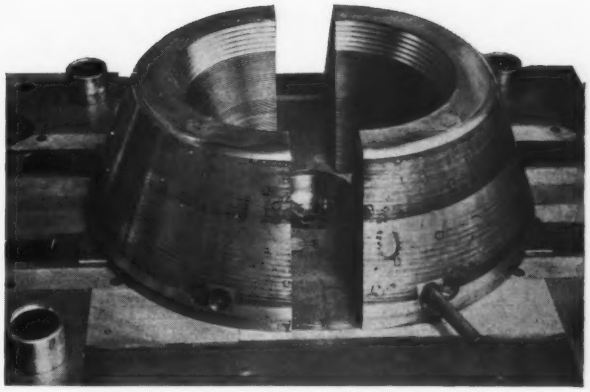


Fig. 9. Split tool for the Thorn lantern.

The clear cover is assembled on to this inner component and cemented to provide a gap seal, again to avoid the ingress of moisture and dirt in industrial atmospheres. Many techniques to disperse volatile elements of the cement were evolved, since if these are trapped within the two halves of the moulding, considerable crazing takes place.

The tool is shown in the open position in Fig. 9. This tool operates on a 16/24 oz Peco injection moulding machine.

The Wardle lantern is made up of two halves, an inner and an outer moulding. The inner component carries a horizontal prism form on its outer face, whilst the outer component carries a vertical prism form on its inner face. The inner component is then dropped within the outer, and cemented in position, with the result that the prisms are completely enclosed. This is an important advantage from the point of view of maintenance, the complete lantern having a smooth interior and exterior, thus minimizing cleaning problems.

Many modifications to the tool were carried out to achieve the right type of fit when the two mouldings are fitted together. This question of fit is important so as to avoid the trapping of volatile elements within the envelope of the two mouldings when cementing takes place. (See Fig. 10.)

Injection techniques have shown that very accurate prism systems are possible. Improved optical characteristics are achieved, resulting in street lighting of higher efficiency. This is an important advance in these days of increasing road traffic, and will undoubtedly help to reduce road accidents in the future.

Fig. 10. Cementing the two mouldings together.

The National Boat Show

Impressions of the part now played by plastics in modern boat equipment and construction

THE boat building industry of this country has not been slow to note, and adopt, the many new synthetic materials that have emerged over the past 10 or 15 years; the new adhesives, nylon and Terylene for sails and running gear, Tufnol for blocks, pulleys and other components, p.v.c. for decking, upholstery and the like, and last, but by no means least, polyester/glass laminates for hulls.

We may consider boats under two main headings—work boats, used by off-shore fishermen, tenders to yachts, harbour craft, etc., and pleasure craft. Whilst the demand for the first group remains fairly constant, the number of small boats built for pleasure is rising every year. Every sizeable stretch of water is now the happy sailing ground of enthusiasts with Cadets, Fireflies, Nationals and Internationals. The sailing bug has bitten the British public just as it has in America, and the field is open for exploitation by the plastics industry. On condition, of course, that if you build the boat in reinforced plastics materials, you build a good, sound boat, at a competitive price.

The Boat Show at Olympia last January provided an excellent opportunity of examining reinforced plastics craft both from the standpoint of construction and cost, for well over 15 exhibitors were showing boats of this type.

First let it be said that quality of construction varied enormously. Some made no pretence of finish, the surfaces having undulating contours exposing the raw chopped strand mat glass reinforcement. In these cases the designs and lines of the craft were equally vulgar, and had obviously not been born in a boatyard. At the other end of the scale were the beautifully finished craft, of which the Halmatic 31 ft. launch, and the whole range of Tod boats were good examples. Tod's of Weymouth have specialized exclusively in polyester/glass hulls and have reached as near perfection as one can with the technique.

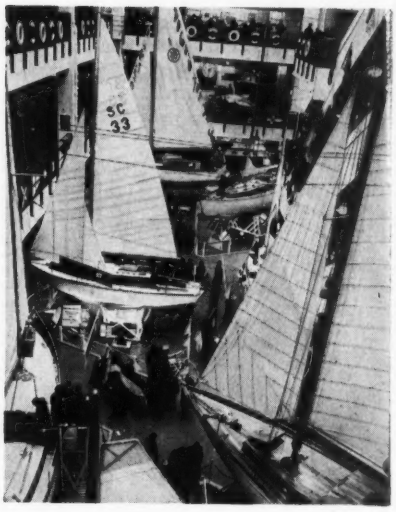
In the matter of cost, or price, an anomaly exists which is hard to explain. 8–12 ft. dinghies range in price from £38–£60. All are more expensive than their traditional wooden counterparts. This despite the fact that to build a 10 ft. dinghy requires about 16–20 working hours, *a sixth of the time needed* to build in wood. Despite the much higher raw material costs of the resin/glass structures, it is still difficult to reconcile the prices asked for these craft in view of the allegedly swift production cycle. It has been argued that the buyer will pay a premium price because of the low maintenance costs afforded by the integral construction, resistance to rot, absence of caulking, etc. To us, however, it seems that whereas almost all the cost of a wooden boat is labour, almost all the cost of the resin/glass boat is raw material and presumably the price will only fall in the event of a drop in raw material prices. If nothing else, of course, the reduction in labour requirements by adopting the resin/glass technique will assist the boat builder at a time when demand is going up and craftsmen are getting scarcer.

The Tod stand comprised five boats. All external colouring was pigmented into the laminates, in whites, greys and greens. Buoyancy tanks were incorporated in the form of moulded seats. A novelty was a translucent glass-fibre fuel tank in the 20 ft. power launch, enabling the fuel position to be checked externally. All of these boats were workmanlike, robust, and with good lines. Beck Koller resins are used.

Hutchings have redesigned their high-speed launch, employing resins made by Mitchell and Smith Ltd., and the result is the " Mermaid," a very smart and powerful job.

Bakelite Ltd., who had their own stand, had also supplied resins to Maximar Mouldings Ltd., Willerby Plastics Ltd., Aero-Marine Sales (London) Ltd., Ceacraft of Solihull, and Tidemaster Motors Ltd. Novelties shown included water scooters which must be great fun. The moulding-in of a serrated flooring to increase foot-hold in the Maximar " Shorty " was a clever design point.

B.I.P. Chemicals Ltd., exhibited a Fleetland 12 ft. run-about, the finish of which was excellent, and could also claim

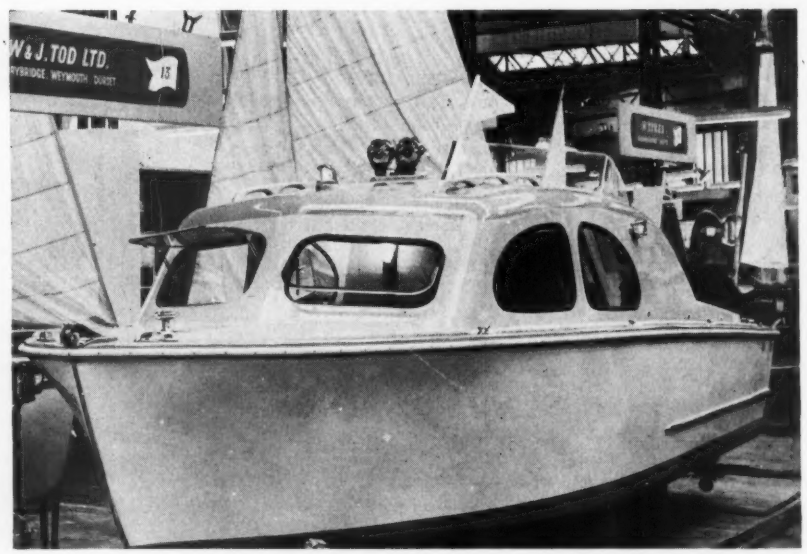


a part in the construction of Miss Windermere III, in which Beetle adhesives were employed.

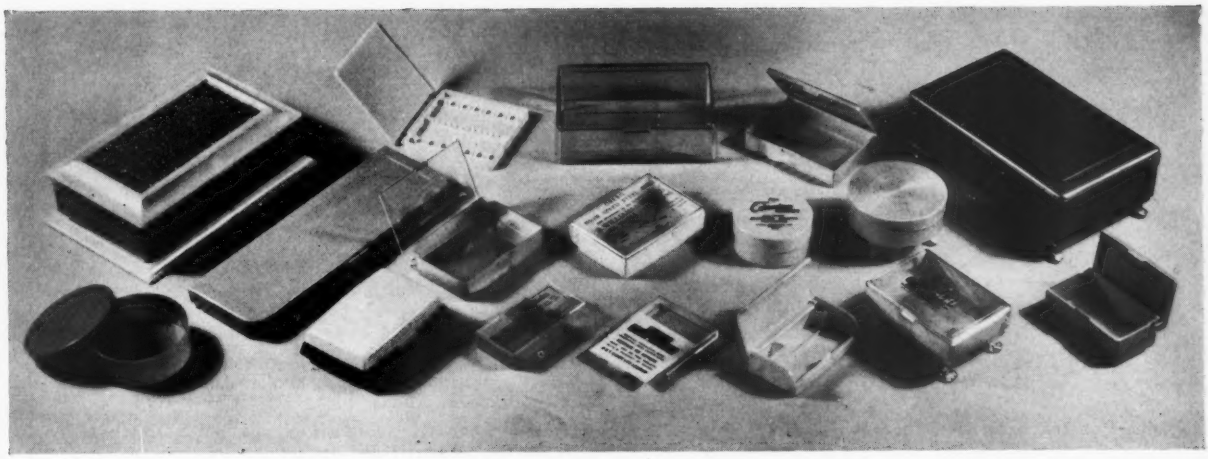
On the stand of Leicester, Lovell and Co. Ltd., the company's technical staff were present to give advice in the use of Casco glues in boat construction. Of particular interest was the use of the laminating technique for such components as stems, keels, knees, etc.

One might sum-up by saying that at each successive boat show our industry plays a bigger part, evidence of the small-craft industry's interest in all that we have to offer. The time may very well be near when the majority, rather than the minority as at present, of small craft will be constructed of plastics materials of one kind or another.

Note: Owing to pressure of space in this issue, the full pictorial record of the Boat Show has been held over to March.



A Tod motor launch—excellent in finish and design.



Injection moulded containers made by the Plastic Box Co., Ltd.

The 1957 Packaging Exhibition

A review of the use of plastics in packaging, as shown at the exhibition

THE Packaging Exhibition is always an exhibition of interest to the plastics industry. No one has yet worked out the quantity of plastics materials which the packaging industry absorbs but the figure must make this industry one of our best customers. On this premise it is worth considering some of the developments before reviewing the exhibits shown this year.

First of all the well established polythene bag. Although this has been on the market for a considerable number of years now, the growth in its use except in more specialized applications has not been phenomenal. It has been gratifyingly steady and its reputation is sound. This year the introduction of several new types of machinery for making and handling the bags gives some indication of the increased interest in the material and augurs well for the future.

Secondly, and perhaps of more significance, is the determined efforts of several companies to " put over " the bubble pack. Efforts, we may add, which appear to be meeting with considerable success and we expect within the next few years to see a considerable increase in the use of this attractive and economical package. Amongst its advantages is simplicity of production, low cost of machinery needed, attractive appearance, ease of assembly, and for the retailer, speed and ease of handling. Two further points whilst dealing with vacuum forming which is so closely linked with the bubble pack. Only two companies showed skin packaging. And aluminium foil for frozen food containers seems to be in favour at the moment.

Materials

B.X. Plastics Ltd. showed the widest range of plastics materials at the show. These included polythene, acetate, polystyrene and rigid and flexible vinyl materials. A new product, Polybex, was also displayed. This is an expanded polystyrene which is extremely light and also very tough. It is supplied in granular form with a blowing agent. Heating within a mould expands the material into a rigid form. By using moulds of suitable design this final form can take any shape suitable for nesting delicate parts in transit. Further examples afforded by plastics materials for the packing of fragile articles were the vacuum-formed cushions used within cardboard containers. These are both effective and economical, two factors which should ensure their wider adoption.

British Celanese Ltd. exhibited samples of packing in Celawrap, Cellastine and Clarifoil. The latter material was being vacuum formed on a Daniels/Latymer machine in the continuous production of bubble packs. Also examples of a new technique of window lamination giving an all-over gloss in addition to the window were exhibited.

British Visqueen Ltd. provided a pictorial display which emphasized the properties of Visqueen polythene film in many specialized packaging outlets.

Commercial Plastics Ltd., in conjunction with Anglo-American Plastics Ltd., showed examples of the use of Fablothene polythene film and p.v.c. sheeting and bags in packaging. The Iridon Division of this company had on display vacuum formed containers made from high impact polystyrene sheet which is manufactured by this division.

The Clyde Paper Co., Ltd., showed many examples of polythene-coated paper and other materials. These included polythene-coated board for ice-cream containers and polythene-coated aluminium foil used for packing dehydrated soups to name but two.

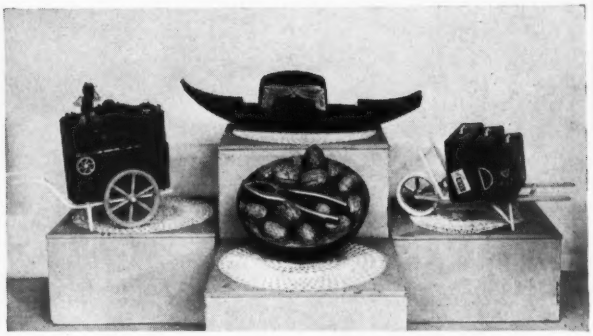
The Goodyear Tyre & Rubber Co. (G.B.), Ltd. Two new film materials Pliofilm F.M.I. and 75 BF were shown. The former for prepacking meat, poultry and fish, for deep freezing, and the latter for use with processed meat and cheese. Pliofilm is a rubber hydrochloride film of excellent clarity.

Greenwich Plastics Ltd. A more detailed description of their new p.v.c. packaging film Craytherm appears on page 47 of this issue.

J. H. Sankey & Sons, Ltd., introduced

The stand of Telegraph Construction & Maintenance Co., Ltd., showing in the foreground the machine used for demonstrating the use of Telcophane film for packing food.

A selection of vacuum formed packages by Alfred Eva & Sons, Ltd.



Injection moulded fancy containers moulded in Italian moulds and shown by Pandora Italia.

Moistop a polythene-coated reinforced packing paper.

Telegraph Construction & Maintenance Co., Ltd., demonstrated on their stand the packing of food in their new Telcophane film. This film is made from polythene-coated cellulose film by the extrusion process which is also used for the range of coated papers also displayed on their stand. Polythene-coated aluminium foil was also shown.

Fabrications

Blewis & Shaw (Plastics) Ltd. Amongst the wide selection of thermoplastic containers on view were some polystyrene injection moulded cosmetic cream jars. Of similar design to the more familiar opal glass jar the plastic container is moulded in two parts and is considerably lighter than its glass counterpart.

Cascelloid As usual this company had something new to offer in the way of polythene containers. As well as a wide range of bottles and tubes in different styles, sizes, and colours, they introduced a protected container made of sheet steel into which the standard polythene container fits. This must now be one of the safest containers manufactured. It is interesting to note that this company is also manufacturing food trays and containers from aluminium foil.

John Dale Ltd. Several new tube caps moulded in polythene were part of a display which included plastic containers, tubes and closures of different designs and colours, many of them produced for well-known proprietary brand commodities.

John Dale also introduced the Poly-seal closure, for which they have just obtained the U.K. manufacturing rights. This is a threaded closure with a conical polythene liner, and shows unusual promise in eliminating leakage, evaporation and contamination problems inherent to flat, disc-type liners. The conical liner is designed with a centre sleeve which fits over a pin moulded into the cap. The cone takes the shape of the container finish, providing sealing surfaces that bear down and conform to both horizontal and vertical surfaces. Potential applications include pharmaceuticals, cosmetics, beverages, food, and household products.

John Dickinson Ltd. A new feature on display by this company were bubble packs of various designs including a dispensing pack which releases the contents of the "bubble" singly. This should be of interest to pill and tablet manufacturers as the pack must be only a fraction of the cost of a bottle.

Alfred Eva & Sons, Ltd. Into the vacuum-forming field comes a newcomer. Alfred Eva had a comparatively small display of containers and inserts with which to enter the market but as they are established carton manufacturers the next exhibition will probably see a larger display with some well-known names displayed.

Fibrenyle Ltd. Bottles and containers in capacities ranging from 5 c.c. to 13 gallons moulded in polythene were displayed. In addition some nylon bottles were shown.

Injection Moulders Ltd. This company who are trade moulders had a comprehensive range of injection moulded exhibits which depicted the service which they can offer the packaging industry. Included were several nylon containers.

Ivers-Lee (Great Britain) Ltd. The packaging service offered by this company is well known. A recent introduction to the service is a skin forming method of packing and several examples of this were exhibited.

Henry Jackson (Liverpool) Ltd. showed some of the uses to which polythene bags can be put. A stalk of bananas covered this way was prominently displayed.

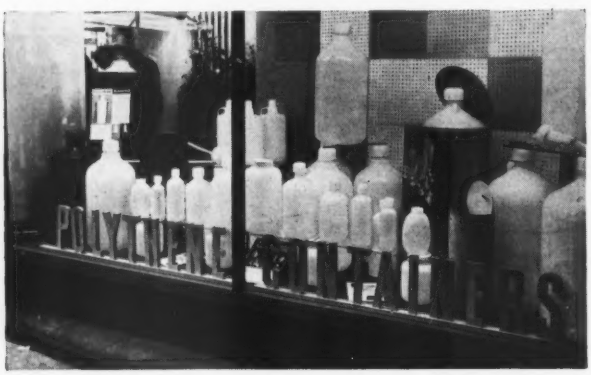
Microcell Ltd. Specialized packaging structures were exhibited, including glass reinforced plastic containers.

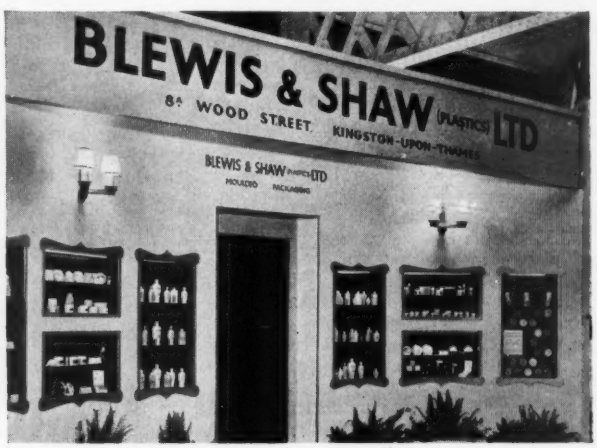
Pandora Italia. An eye-opening display of plastic containers, caskets and novelties moulded from Italian moulds should have caused designers to pause and ponder. These injection moulded containers were originally created for the Italian confectionery and cosmetic trade. One wonders, however, what is the ratio of cost between the container and its contents.

The Plastic Box Co., Ltd. A company specializing in the manufacture of injection moulded containers and boxes can be expected to have a large display and visitors were not disappointed. As the majority of these boxes are stock lines a very real service is offered to the potential user of plastics for his display and packaging requirements.

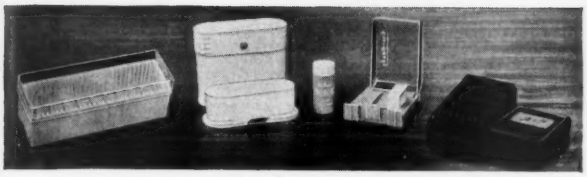
Plastic Weldings Ltd. Originally developed in France the Vitherm welded p.v.c. containers are now made under licence by this company and were shown on their stand. Made from transparent or coloured p.v.c. with double welded seams these collapsible packs are enclosed in a suitable rigid container.

Prestware Ltd., with their associates Lustroid Limited, showed mouldings designed and produced for one specific purpose. These were in a variety of thermoplastic materials as well as some of the thermosetting plastics and





(Above) A display of polythene containers, including the armoured container on the stand of Cascelloid.
(Right) The stand and display of Blewis & Shaw (Plastics) Ltd.



A selection of mouldings in both thermosetting and thermoplastic materials shown by Prestware Ltd. and Lustroid Ltd.

exemplified the moulding skill of the companies concerned.

Spesco Developments Ltd. One new product shown by this company was the Wexler container which has a reinforcing polythene rim or rib welded to the film as an integral part of the container. Also featured was the Kisss heat sealing machine and an attractive young lady in a bathing costume.

Technopol Laboratories Ltd. The Rado system of filling and sealing was the principal feature of this stand and many examples of its use were shown.

Transparent Plastic Containers Ltd. A new company this, who have promoted and specialized in the production of the bubble pack. Demonstrations on a Daniels/Latymer vacuum-forming machine were being held during the exhibition. Contour and dispensing packs of this type were exhibited and demonstrations of the simplicity of filling and sealing the packs were being given.

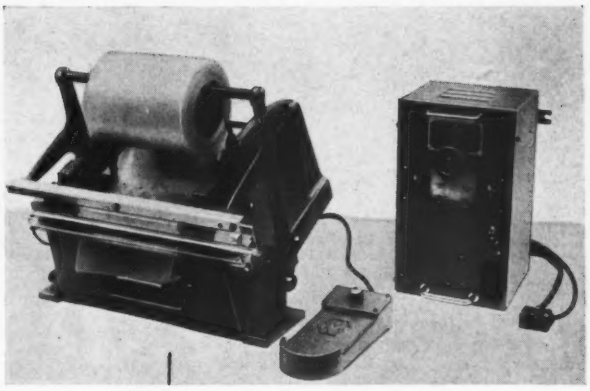
Machinery

Autopack Ltd. showed for the first time a polythene bag opening and feeding machine. This machine automatically selects, opens and holds the bag ready for hand or automatic filling. Bags from 2¼ in. × 5¼ in. to 5¼ in. × 13 in. can be used on the machine.

A. H. Bland (Engineers) Ltd. showed an extremely wide range of heat sealing equipment including continuous band sealers, automatic bag making machines as well as a variety of hand, bench and standard sealing equipment. Suitable machines were also shown for the sealing of polythene-coated materials.

Charles E. Douglas & Co., Ltd., also exhibited a fully automatic polythene bag making machine and a semi-automatic machine.

Manifold Machinery Co., Ltd., were a third company and the newest to provide an automatic bag making machine. This machine will produce bags up to 39 in. wide and from 2½ in. to 104 in. in length. Manifold also displayed smaller heat sealing machines.

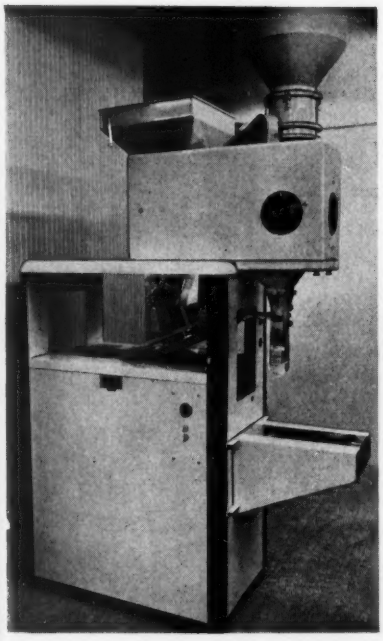


Heat sealing equipment for polythene bag making shown by Manifold Machinery Co., Ltd.

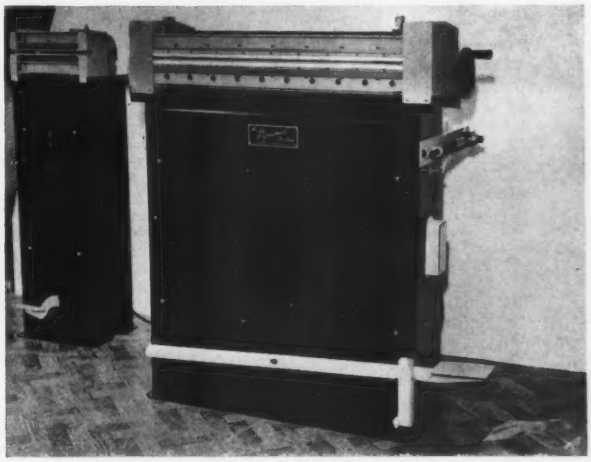
Addresses

Given below is a list of addresses of the companies mentioned in this review.

Autopack Ltd., Caroline Street, Birmingham, 3.
B.X. Plastics Ltd., Highams Station Avenue, London, E.4.
Bland, A. H. (Engineers), Ltd., Beaconsfield Road, Hayes, Middlesex.
Blewis & Shaw (Plastics) Ltd., 8A Wood Street, Kingston-on-Thames, Surrey.
British Celanese Ltd., Celanese House, 22/23 Hanover Square, London, W.1.
British Visqueen Ltd., Six Hills Way, Stevenage, Herts.
Cascelloid, Abbey Lane, Leicester.
Clyde Paper Co., Ltd., The, Rutherglen, Glasgow, Scotland.
Commercial Plastics Ltd., Willington Quay, Wallsend-on-Tyne.
Dale, John, Ltd., Brunswick Park Road, New Southgate, London, N.11.
Dickinson, John, Ltd., Apsley Mills, Hemel Hempstead, Herts.
Douglas, Charles E., & Co., Ltd., Cecil Chambers, 86 Strand, London, W.C.2.
Eva, Alfred, & Sons, Ltd., Geva Works, Harper Road, Wythenshawe, Manchester.
Fibrenyle Ltd., 157 Dukes Road, Western Avenue, London, W.3.
Goodyear Tyre & Rubber Co. (G.B.), Ltd., Bushbury, Wolverhampton, Staffs.
Greenwich Plastics Ltd., St. Mary Cray, Kent.
Injection Moulders Ltd., Westmoreland Road, London, N.W.9.
Ivers-Lee (Great Britain) Ltd., 113 Farnham Road, Slough, Bucks.
Jackson, Henry (Liverpool), Ltd., Admiral Street and High Park Street, Liverpool, 8.
Manifold Machinery Co., Ltd., Suffolk Works, 660 Great Cambridge Road, Enfield, Middlesex.
Microcell Ltd., 56 Kingsway, London, W.C.2.
Pandora Italia, 147A Kensington High Street, London, W.8.
Plastic Box Co., Ltd., The, White Hart Court, Market Rasen, Lincs.
Plastic Weldings Ltd., 11B Strafford Road, Acton, London, W.3.
Prestware Ltd., Southdown Works, Kingston Road, Raynes Park, London, S.W.20.
Sankey, J. H., & Sons, Ltd., Aldwych House, Aldwych, London, W.C.2.
Spesco Developments Ltd., 195 Uxbridge Road, Hampton Hill, Middlesex.
Technopol Laboratories Ltd., Wigton House, 212 St. John Street, Clerkenwell, London, E.C.1.
Telegraph Construction & Maintenance Co., Ltd., Farnborough Works, Green Street Green, Farnborough, Kent.
Transparent Plastic Containers Ltd., Imperial Buildings, Waterylane, Birmingham, 9.

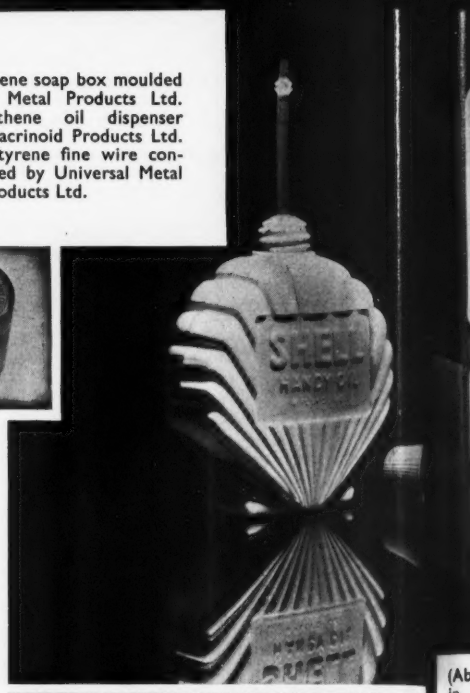


(Left) The Autopack automatic polythene bag opening and filling machine.



(Right) The Bland semi-automatic sealing and bag making machine for use with polythene film.

(Left) Polystyrene soap box moulded by Universal Metal Products Ltd. (Right) Polythene oil dispenser moulded by Lacrinoid Products Ltd. (Below) Polystyrene fine wire containers moulded by Universal Metal Products Ltd.

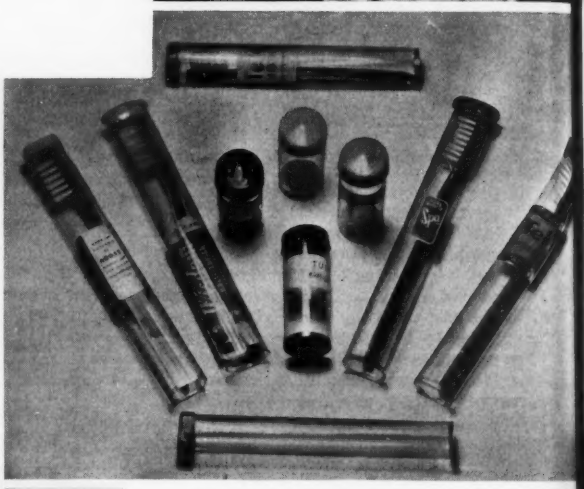


Plastics in the Service of Man

71. Plastics in Packaging

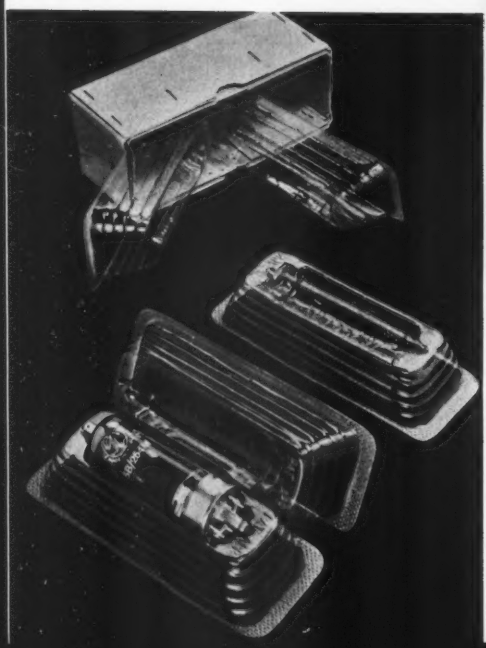
A list of trade names and companies mentioned in this review, with full names and addresses appears on page 64

(Above) Acetate film sleeve wrap supplied by British Cellophane Ltd.
(Right) Glass sweet jar with plastic cap and polythene cover supplied by Low & Bonar Ltd. Design by W. M. de Majo.



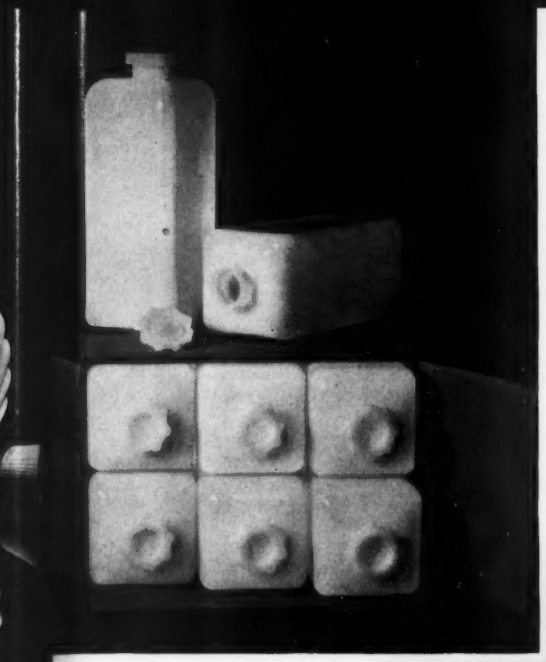
(Above) Acetate containers manufactured by Thos. de la Rue & Co., Ltd.

(Above) Polythene containers for solid cologne, moulded by Mentmore Manufacturing Co., Ltd.



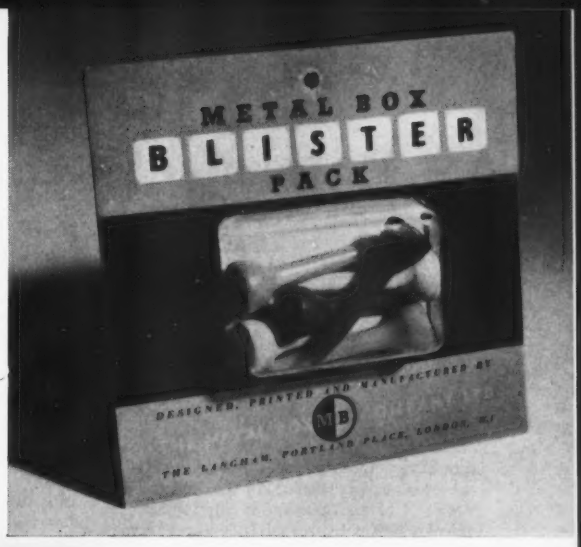
(Left) Vacuum-formed cushion for valves formed from Bexoid cellulose acetate.

(Below) A selection of cosmetic containers moulded by E. Shipton & Co., Ltd., in Alkathene.

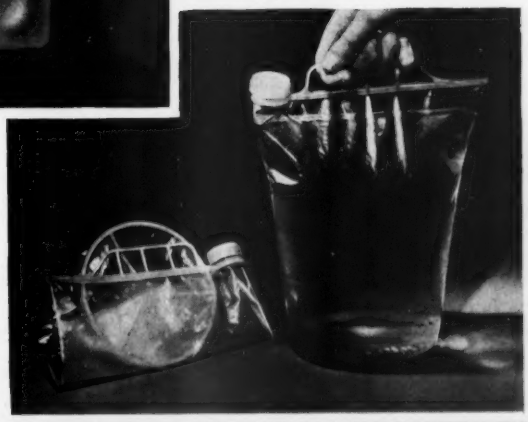


(Above) Containers moulded in Alkathene by Damancy & Co., Ltd., of Ware, Herts.

(Right) Bubble pack formed from cellulose acetate by The Metal Box Co., Ltd., The Langham, Portland Place, London, W.1.

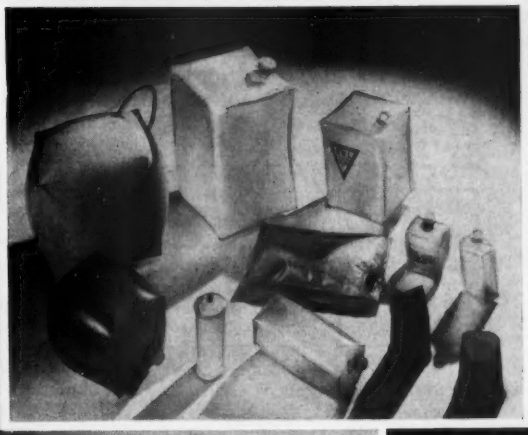


(Below) A Wexler folding bottle produced by Spesco Developments Ltd.



(Below) Fibroceta bonded acetate staple wadding developed by Courtaulds and sold by Southalls (Birmingham) Ltd., Charford Mills, Birmingham, 8.

(Right) Vitherm p.v.c. containers made by Plastic Weldings Ltd.

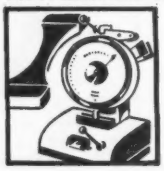


(Below) Pillows packed in B.X. polythene film made from Bakelite material. Package by Polyplastic Converters Ltd.

(Above) Injection moulded polystyrene containers moulded by Injection Moulders Ltd.

World's Industry Employs Plastics

MATERIALS and TESTING



Incorporation of metals into polymeric materials.—Under 'metallic reinforcement' those reactions are understood which allow low molecular weight molecules, possessing potentially functional groups, to be converted into high molecular weight molecules by means of active metallic compounds. F. Schlenker gives a review of recent results obtained, specially referring to raw materials for varnishes. With these materials the gap between plastics of purely organic nature and those with mainly inorganic characteristics is bridged.
(*Kunststoffe*, 1957/Jan./7.)

Plasticized p.v.c. compounds.—H. Sontag deals with the properties of plasticized p.v.c injection moulding compounds. Reference is made to the correct injection moulding characteristics such as ratio of temperature, injection pressure, mould temperature, ejector design, shrinking after treatment, etc.
(*Kunststoffe*, 1957/Jan./45.)

Flow properties of moulding materials.—Von Meisenbug discusses some characteristics of flow curves obtained with a previously described apparatus. This is suitable for thermosetting as well as thermoplastic materials in powder and chip form. The different behaviour of the various types of plastics is clearly demonstrated.
(*Kunststoffe*, 1957/Jan./14.)

Testing of hard foam materials.—New German draft standards for the testing of hard foam materials have been published for comment: Foam materials, definition, classifications DIN 7726, shear test DIN 53422, compression test DIN 53421, determination of density in the rough condition DIN 53420, bending test DIN 53423; these draft standards have been published with explanations.
(*Kunststoffe*, 1957/Jan./30.)

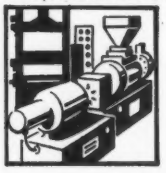
New custom conditions for plastics and plastic products.—Survey about legal conditions based on recent regulations (Aug. 15, 1956.)
(*Kunststoffe*, 1957/Jan./28.)

Poly-alpha-methyl styrene. Alpha methyl styrene has been homopolymerized to high molecular weight by the use of Friedel-Crafts catalysts. More brittle than polystyrenes of the same molecular weights, it is desirable to keep molecular weights at a minimum value to improve ease of moulding and extrusion. Alpha styrenes are stiffer, and have lower thermal stability than normal polystyrene. Poly-alpha-methyl styrene, made by sodium catalysis is clear, colourless, and of excellent electrical properties. This polymer is less soluble in aromatic and halogenated solvents than polystyrene, is more sensitive to thermal degradation during processing, but has a heat distortion temperature in the form of compression-moulded samples of 150°C. Injection moulded samples have been found to yield tensile strengths in the order of 8570 p.s.i.
(*Industrial and Engineering Chemistry*, 1956/Dec./2123.)

Ionic derivatives of polyacrylamide. Polyacrylamide is a neutral, water-soluble polymer, essentially nonionic in character. As such it has many existing as well as potential uses. In a number of applications, polyectrolytes differ markedly from nonelectrolytic polymers. Ionic derivatives have been prepared from polyacrylamide through its chemically reactive amide groups in order to enlarge the scope of its possible uses. Three types of product are described in this article: (1) anionic derivatives; (2) cationic derivatives; (3) cationic derivatives via the Mannich reaction with formaldehyde and amides.
(*Industrial and Engineering Chemistry*, 1956/Dec./2132.)

Polythene production by radiation. In a paper given before the Tracerlab Symposium in Boston, Mr. J. J. Morten suggests that polythene could be produced for as little as 27.5 cents per pound by using gamma radiation. The process suggested is by the charging of ethylene under pressure of 3,000 p.s.i. into a reactor which polymerizes it. The polymer is washed out by solvent sprays and the resulting slurry is fed into a high pressure separator where the unreacted ethylene is returned and the polymer fed to an extruder.
(*Chemical & Engineering News*, 1956/Nov. 19/5758.)

PROCESSES : MACHINERY



Rotational casting of p.v.c. pastes.—Slush or rotational moulding has been used for manufacturing of balls, dolls and similar hollow bodies. Special machines have been developed for this process.
(*Kunststoffe*, 1957/Jan./49.)

Control of insulated wire diameter.—C. M. Fredrickson and C. D. Gibbs report on tests with an electronic diameter control device. The operation of this device is described and a number of case histories are given.
(*Wire and Wire Products*, 1956/Dec./1453.)

Formvar-airslip process.—Difficulties in the manufacture of deep components occur if the bottom area is large in relation to the total cross-section. The edges of vertical sides undergo pronounced thinning and unilaterally orientated stretching. In the described process the sheet is first uniformly blown up by hot air at controlled pressure.
(*Kunststoffe*, 1957/Jan./23.)

Electronic welding of plastics. A review of the progress made in the welding of plastics and in particular of p.v.c. for garment manufacture is given. The review includes descriptions of welding machines of various ratings and the design of electrodes for use with them.
(*Materie Plastiche*, 1957/Jan./36.)

INDUSTRIAL APPLICATIONS

Plastic protects temperature controller.—A plastic dipping process giving a thickness of 0.005 in. protects the thermal element of a self-operating temperature control bulb for maintaining the temperature of metal finishing solutions. Solutions range from 0 to 13 pH at temperatures up to 250° F. The coating does not significantly affect the response of the instrument.
(*Products Finishing*, 1956/Dec./66.)

A high voltage power cable insulated with polyethylene has recently been tested. It was a 3-conductor 5 KV aerial cable of the following construction: 350 MCM 37 wire aluminium strand, strand shielding, Marlex 50 polyethylene-8/64 in., bedding tape, copper shielding tape, polyvinylchloride jacket, 3 conductors cabled and lashed to messenger.
(*Wire and Wire Products*, 1956/Dec./1451.)

Plastic laboratory fume hoods are now manufactured in many different sizes by specialist firms. They give resistance to the corrosion of a wide variety of acids. Fume ducts and exhaust systems can be made up of standard size ducts and fittings to meet almost any condition.
(*Products Finishing*, 1956/Nov./130.)

MISCELLANEOUS USES

Plastic-coated wrapping papers.—Plastics are used to-day as additives to the paper pulp and as coating and protecting material; in the latter case plastics may be used alone or in combination with paraffins and pigments. The properties of the most important plastics for protecting papers are discussed as well as their manufacture. It is referred to both advantages and disadvantages.
(*Kunststoffe*, 1957/Jan./2.)

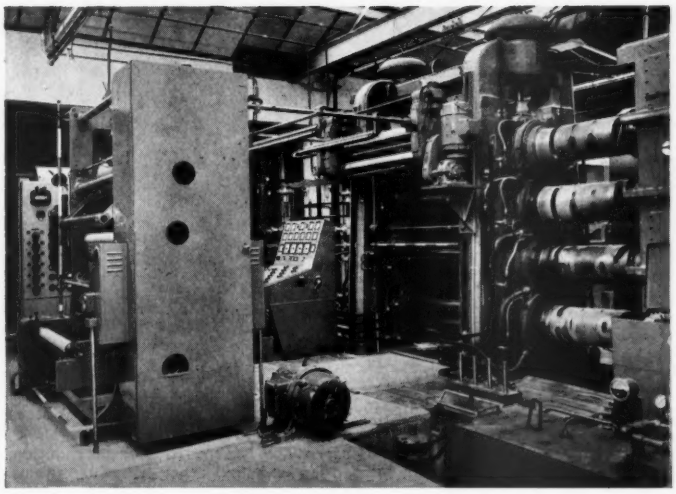
Silicone finish on a hot hose.—A flexible metal hose with right-angle bend, connecting exhaust manifold and tail pipe of the Continental Mark II automobile is coated by a heat-resistant Silicone finish. It withstands a 24-hour temperature test in excess of 1,000° F., which actually is above normal operating temperature.
(*Products Finishing*, 1956/Nov./90.)

"THE PROPERTIES AND TESTING OF PLASTICS MATERIALS"

This series of articles which has been running in *Plastics* since March, 1955, is shortly to be published in book form by Temple Press Ltd. Publication date, price, etc., will be announced shortly.

RECENT DEVELOPMENTS IN PLASTICS MATERIALS

A Symposium on the above theme will be held by the London Section of the Plastics Institute at the Borough Polytechnic on March 27. Papers on high-density polythene, polyurethanes, nylon 6, and epoxides will be read. All enquiries should be made to the Plastics Department, Borough Polytechnic, London, S.E.1.



Unplasticized P.V.C. Film for Packaging

One of the highlights of this year's Packaging Exhibition, Craytherm's production and properties are briefly described here

A view of the new plant installed at Greenwich Plastics Ltd., for the manufacture of unplasticized p.v.c. film.

IN our review of the Packaging Exhibition it has not been possible to provide readers with more than a brief note on some of the interesting developments which have taken place in this expanding field of plastics consumers. We are, however, able to publish here a more detailed description of what was an exceptional exhibit on the stand of Greenwich Plastics Ltd. We refer to their introduction of unplasticized p.v.c. film known as Craytherm, which is now being produced at their works at St. Mary Cray, Kent.

It is only just over a year ago that Craypak, the plasticized p.v.c. film, was introduced by this company and readers will recall the description of its production which appeared in the January, 1956, issue of *Plastics*. Briefly, this material is an extruded film of excellent clarity having a tensile strength of 4,500 p.s.i. The new Craytherm film is produced by a different technique developed in Germany and known as the Luvitherm process, Greenwich Plastics being the sole licencees in this country for its manufacture. This process employs calendering operations carried out on a Berstorff calender using special imported raw material. Two grades of film are being produced, Craytherm U and Craytherm S. The former is an unstretched grade and the latter a longitudinally stretched grade with high longitudinal tensile strength.

Fabrication

Tests have shown that the unplasticized film can be printed by the photogravure, letterpress or silk screen processes using conventional vinyl printing inks. Gold blocking can also be carried out.

Heat-sealing Craytherm on the Greenwich stand.

The usual high frequency welding or heat sealing techniques can be used with Craytherm U which is recommended for this fabricating technique. Joints can also be made by using a suitable adhesive or wetting with a solvent such as cyclohexanone.

For vacuum forming the heaviest gauge, Craytherm U 200, has a maximum depth of draw of approximately 1 in.

Applications

The non-toxic properties of the film has suggested its use in a wide range of packaging applications particularly for foodstuffs, either as a wrapping film or formed container.

Other possible applications include its use as a gloss laminating

PROPERTIES

Test	Type of Film	Results
Specific gravity	Both	1.38
Tensile strength (B.S.1763) ...	Craytherm U	Longitudinal 6,500 p.s.i.
	Craytherm U	Transverse 6,500 p.s.i.
	Craytherm S	Longitudinal 16,000 p.s.i.
	Craytherm S	Transverse 6,000 p.s.i.
Elongation at break	Craytherm U	Longitudinal 100%
	Craytherm U	Transverse 60%
	Craytherm S	Longitudinal 40%
	Craytherm S	Transverse 10%
Dimensional change at 100° C.	Craytherm U	Longitudinal 6% loss
	Craytherm U	Transverse 2% increase
	Craytherm S	Longitudinal 40% loss
	Craytherm S	Transverse 20% increase
Working temperature ...	Craytherm U	80° C.
	Craytherm S	60° C.
Moisture vapour transmission rate	Craytherm U 30	15 g/sq. metre/24 hours
Water absorption (20° C.) ...	Both	Negligible
Blocking	Both	Surfaces slide freely
Ageing and exposure... ...	Both	Good under temperate conditions. Yellows under prolonged exposure under tropical conditions.
Volume resistivity	Both	10^{15} ohm/cm.
Breakdown voltage	Both	40 KV/mm.
Dielectric constant (50 cycles)	Both	4
Resistance to acids	Both	Resistant to most dilute and concentrated acids. Attacked by concentrated aqua regia, hydrofluoric acid and acetic acid.
Resistance to alkalis	Both	Resistance to most dilute alkalis. Not resistant to very concentrated alkalis such as potassium hydroxide and ammonia.
Flame resistance	Both	Good
Low temperature properties	Both	Thinner gauges—excellent
Effect of organic solvents ...	Both	Not affected by alcohols, swells in ester solvents and is not resistant to ketones and chlorinated solvents. Resistant to petrol.

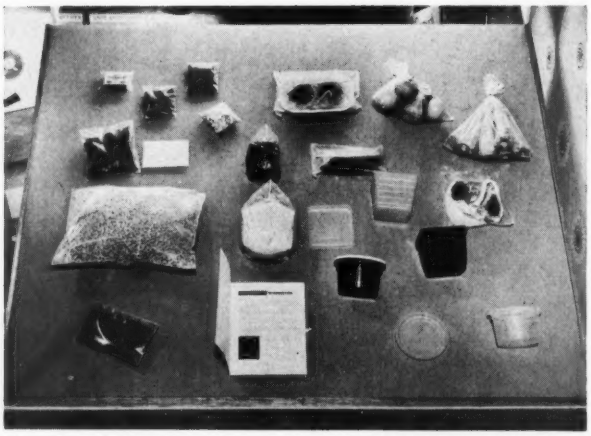
material to cardboard or paper, for the protection of book covers, and as the basis for pressure sensitive tapes. The type S film is recommended for use as a sound recording tape.

The range of thicknesses in which this film is available is given in the table below.

Gauge No.	Average Thickness. In.	Approximate Yield. Square feet per lb.
25	0.001	140
30	0.0012	115
40	0.0016	85
50	0.002	70
60	0.0024	55
100	0.0039	35
150	0.0059	25
200	0.0079	17

Craytherm U is not available in Gauge 25.
Craytherm S is available only in the Gauges 25, 30 and 40.

Further advice on applications and properties can be obtained from the Technical Service Department of Greenwich Plastics Ltd., St. Mary Cray, Kent.



Examples of Craytherm in use, shown at the Packaging Exhibition. Seen here are apples, meat, dried fruit, and other household items.

LETTERS TO THE EDITOR

Correspondents are reminded that a stamped addressed envelope should be enclosed in all cases where a personal answer is desired. It is understood that any letter received may be published at the discretion of the Editor.

Polythene Pipes for Cold Water Supply

SIR,—Although polythene pipes for cold water were introduced as Alkathene tube in Great Britain over a decade ago, questions have recently been asked about their durability and we believe it may be of value if we summarize briefly the results of our experience in the hope that doubts will be removed about the suitability for this application of low density polythene made by the high pressure process.

The type of Alkathene, the anti-oxidants used and the degree of dispersion of the carbon black are all important and standards have been laid down in British Standard, B.S. 1972, " Polythene tube for cold water services." Polythene tube made to this standard or similar standards can be operated at an approximate working stress of 350 lb. p.s.i. (25 kilos per sq. cm.) at 20°C.

Since 1946 over 50,000,000 ft. of such tube have been installed in Great Britain. The tube is still giving satisfactory service under a wide variety of conditions and such is the confidence of the user that over 1½ million feet have been installed each month in 1956.

Tube of this specification has never failed in service for unexplained reasons and brittle fractures have not been observed in approved tubing. It is therefore our belief that tube made to this or any similar standard for cold water services will give satisfactory performance over long periods of time.

A. RENFREW.

Imperial Chemical Industries Ltd.,
Plastics Division,
Black Fan Road,
Welwyn Garden City,
Herts.

Plastic Dials for Telephones

SIR,—We are writing to thank you for publishing our inquiry regarding the above matter, in the January issue of *Plastics*.

The result has been wonderful, and we are now able to place an order for the dials we require. May we state here that we have replied to all the firms who wrote to us and feel certain that we have made some very good business contacts.

R. ASH & SON, LTD.

446 and 519a Cheetham Hill Road,
Manchester, 8.

British Plastics Exhibition, July 10–20, 1957

SIR,—I write to inform you of two proposals which I am sure will command your interest and support.

The experiment in 1955 of showing a selection of well designed plastics products in the British Plastics Exhibition at Olympia is to be repeated in 1957. The organizers of the exhibition have again offered space to the Design Committee of the Plastics Institute in which to show such a selection. In view of the international participation in the next exhibition this selection will not be limited to British made products, but because of space limitations the selection will be limited to finished consumer goods and will not include industrial mouldings and components.

I am glad to announce also that the Council of Industrial Design has agreed to co-operate with the Plastics Institute in staging at the Design Centre, Haymarket, London, a special display of plastics consumer products to coincide with the British Plastics Exhibition.

In order that these two displays of well designed plastics consumer goods may be fully representative of the industry, all British plastics manufacturers (whether or not they are participating in the British Plastics Exhibition) are invited by the Plastics Institute and the Council of Industrial Design to submit to the C.O.I.D. as early as possible, examples of the items they would like to be considered. Such submissions, marked " Plastics Display," should be sent direct and *not later than April* 30, 1957, to Major-General J. M. Benoy, Manager, The Design Centre, 28 Haymarket, London, S.W.1.

Those items that are selected by the Council's Selection Committee for display in the Design Centre will be chargeable to manufacturers at the Council of Industrial Design's normal display rates which range from 2s. 6d. to 7s. 6d. per day, according to size. The C.O.I.D. would keep them on display for not less than one month.

The Design Committee of the Plastics Institute will arrange a display of selected duplicates of the chosen items on a special stand at Olympia free of charge for the 10 days of the British Plastics Exhibition. These will be shown alongside selected consumer goods from other countries.

I am sure that all British plastics manufacturers, whether of household mouldings, laminated plastics or sheet materials, will wish to take advantage of these two displays and that we may count on a good response from the industry to this invitation which has the approval of the British Plastics Federation.

J. K. WHITE.

The Plastics Institute,
6 Mandeville Place,
London, W.1.

For further *Letters to the Editor*, please turn to page 52.

Reinforced Plastics and Road Transport

By M. D. CURWEN, B.Sc., A.R.I.C.

The following paper, which was first read before the Institute of Road Transport Engineers last December, created keen interest both in the vehicle and plastics industries. It is reprinted here, by kind permission of the Institute.

I HOPE you will not think me too cynical if I remind you that Gibbon once said " History is generally only the register of . . . . the follies and mistakes of Mankind." If we take heed of them, we progress. You may reply that Ford said " History is bunk ! " but you will remember also that he said with regard to his motor cars " You can have any colour so long as it's black " and for a long time produced only the T-model. The glass-fibre/resin structures may one day give you any self-coloured job and does produce any shape.

The beginnings of the glass-fibre reinforced plastic industry resulted in many follies and mistakes and it is not surprising, since only 15 years of its life have gone by, that some faults continue. Nevertheless important advances have been made and a very wide range of structures including commercial vehicle bodies have been on the market for some years. What follows is a description in very general terms of the raw materials and methods employed and of some of the difficulties that face the beginner entering the industry.

I am confining my notes purely to the glass-fibre and polyester combinations since they are the commonest and perhaps the only types used in your field. If we talk of plastic reinforcements generally the choice is wider: resins such as phenolics, p.t.f.e., silicones, epoxy, melamine, etc., and reinforcements such as asbestos, wood, paper, nylon, Terylene, cotton, etc. Glass fibre has a great tensile strength but this is not very important in your industry. Stiffness and high impact strength are more so. The story of these new structures goes back only some 15 years ago and began with the examination in the U.S.A. of polyester resins, modifications of a type used for many years by the paint industry.

They are viscous materials with molecules of great length, which by mixture with a substance such as styrene (a mobile liquid resembling coal tar benzene very closely) and the addition of a catalyst to hasten the reaction, can be changed to a rigid solid that remains solid even when heated to an elevated temperature. The reaction may be roughly compared to the making of a ladder. Two long poles of wood may be likened to the long molecules of the primary resin for when apart they can be moved or made to " flow." Once the rungs are in position, the ladder is rigid. In the case of the newly converted solid resin the molecules are said to be cross-linked by the styrene molecules and it, too, is rigid.

As you will note from the sample of cast cross-linked resin shown here, it may be called hard (although by no means as hard as most metals). It is not exceptionally resistant to impact but reinforcement with glass fibre increases this type of strength greatly.

The reinforcement of these resins with glass fibre was first carried out in the U.S.A. during the early war years using a glass woven fabric impregnating it with the primary viscous resin, styrene and catalyst mixture, using a brush. It was then hardened into a rigid sheet or other shape. Thus began the construction of a great number of strong units and components for the services the most important being radomes (radar equipment housings) since they are transparent to short waves and are light and strong, air ducts because they can be rapidly made without the need for beaters or welding, flat sheet for insulation, and so on.

Production in the U.S.A. during 1944 was of the order of 70,000 tons.

The Post-war Period

The war ended and production, almost entirely confined to " war materials," dropped rapidly and severely, as was to be expected, to about 4,000 tons by 1947. Obviously, by then, peace-time uses had been foreseen—the strength of the material coupled with the advantages possessed by plastics, the apparent ease of manufacture by the least technical of workers, the possibility, even the certainty of making monocoque multi-curved forms eliminating metal-beating and welding, was a fascinating proposition never before presented to the world. It attracted industrialists great and small and soon the veriest amateur.

The first shock to all was that glass fabric was an expensive raw material and that polyester resins were not much below it in price. Clearly the economics of war bore little relation to peace-time conditions; few structures made could be sold in serious competition with commercial traditional structures made from metal or wood.

And so it was on demand that glass fibre loose or matted forms as opposed to fabric were made for the industry, but solely on the demand for cheapness. They appeared without any indication that any change in method from that used with fabric was necessary—the paint brush still held sway. It is certainly true that a number of experienced workers in the field uttered words of caution at this early stage, but the glittering promises of an increasing army of travelling self-styled technicians talked louder: (1) of low cost moulds—wood and plaster of paris; (2) no heat; (3) no pressure; (4) no expensive plant or equipment; (5) of no skilled labour; and (6) of no special requirements for premises. I deny that these advantages exist generally. The first does apply on occasion, as in the wet lay up process, but is tending not to apply. In pressure jobs, it does not apply at all. The second, third and fourth again only apply to certain types of system employed, while the fifth and sixth advantage never existed other than in the imagination of the aforesaid self-styled technologist. It approached far too closely in a dangerous form to that modern excrescence, the " Do it yourself campaign."

The Impregnation Process

By now, those of you who are already making these structures, have realized that for the first time in your history you are making your own basic material, for you never made your steel or aluminium sheet. I assure you that never before has the plastics industry asked its customers to do so, for as you probably know it normally supplies moulders and fabricators with a finished plastic, finished so far as its physical, chemical and other characteristics are concerned but in powder or sheet form. The moulder or fabricator presses these into a hot or cold mould to get the required shape.

You are not supplied with a finished plastic but are asked to make it *in situ* and to reinforce it at the same time with glass fibre. The final rigid resins being what they are, cannot be made into powder or sheet for your shaping. So that you have to start a little further back and make your own sheet and lay-up your different shapes. It is astonishing and pleasing how readily so many industries have accepted this onus, and have taken such a radical change in their normal activities, in their stride. I am sure of one thing; with patience and understanding the user industries concerned, will benefit enormously by a deeper comprehension of the technology behind it all, and be all the more ready for advances when they come. I stress that you are not carrying out a simple operation. If you think it is, I must

remind you of the placard Lord Beaverbrook kept pointing to on a wall in his war-time Ministry: "All things in war are simple, but the simple is always difficult."

The problem as presented to the user consists in:—

(1) the mixing of a very viscous resin, the polyester, with a cross-linking compound generally styrene, an inflammable liquid. To this is added the catalyst, an organic peroxide which helps the initiation of the cross-linking reaction and so converts the liquid resin into a rigid solid one, and, if heat is not used yet a fourth chemical reagent termed an accelerator which speeds up the reaction. The accelerator is almost invariably cobalt naphthenate, an oil-soluble metal soap. It is absolutely essential that the catalyst must not be mixed together with the accelerator prior to mixing with the other two basic ingredients, the resin and the styrene, for heat is evolved by their simple mixture to a degree that can be dangerous. Thus the resin, styrene, and say the cobalt naphthenate, are mixed first and only when this mixture is homogeneous, is the catalyst to be added and mixing continued. Mixture by this sequence of events makes the final composition safe.

The formula of the composition is quite rigid from the point of view of the quantities to be mixed. It is also essential that the weighing of them be accurate. It is therefore quite absurd to expect untrained workers to carry out such an operation on kitchen balances especially when dealing with the accelerator which is required in very small quantities and which should be weighed in grams and even to fractions of a gram. Obviously the weighing machine should be a work's balance of reasonable accuracy and the mind and fingers trained to such accuracy.

We can now deal with the mixing process itself. The perfect mixing of fluids is quite a difficult matter.

The nature of the polyester mixture demands special care and patience for on its homogeneity depends the smoothness and completeness of the reaction. It is not good practice therefore to use a biscuit tin and hope to get uniformity by using a wooden stick. If the biscuit tin is rusty there is added danger to good work since iron itself is a good accelerator and may induce pre-hardening. These apparently small points are worth knowing for small scale work, and are quite essential in larger operations.

(2) Glass fabric seemed an admirable approach to normal technology being a stiff, self-supporting structure and because of its probable value for use in a calender or simple roller-dip machine and analogous to paper impregnation. The normally close weave, the difficulty of wetting and of eliminating air bubbles brought disappointments; more recent treatment of the glass has somewhat improved this process.

The impregnation of a mat of loose non-woven structures much cheaper than the fabric, brought hopes of deeper penetration and even greater ease of production of irregularly shaped objects also without limit as to size of lay-up. Here again the common method of impregnating by brush brought no relief and punching or stippling brought even more tiny air bubbles into the structure and degraded its strength. If we are aiming at an engineering structure of "high-duty" the process cannot be termed anything but crude and inefficient. Nor is there yet any effective instrument in the broadest sense that is available to analyze or scan the structure for faults on a non-destructive basis. This is the situation so far as it concerns the wet lay-up technique.

Pressure Process

It was soon realized that better results, mainly because of improved impregnation, can be achieved by the use of pressure in one form or another, such as the use of matched moulds, or the rubber bag technique with air pressure or vacuum and so on. Indeed the improvement is seen in a great number of products and more especially in the production of relatively small units and components ranging from crash-helmets and electrical parts to chemical-resistant components made from pug-like mixtures, which, however, must be rigidly and constantly controlled.

Much of this small area work is aided by preforming machines which, by vacuum, suck the loose chopped strand on to a perforated metal mould.

In general, however, the normal lay-up previously described is employed and the resultant wet structure passed to the press. Obviously perfect impregnation cannot be attained by the relatively low pressure used, and furthermore since the system is still chained to the hand application of the liquid resin, the possibility of even distribution throughout the area is not great. Again, the time lag between the application of the resin and transfer to press if large, contributes towards early hardening and therefore against improved impregnation.

In Great Britain and Europe the process of production of a boat because of size invariably ends with the previously described lay-up process. This latter process is also employed more often than not in the U.S., but the important point is that the use of pressure in some form or other is now more common and is growing in American technique. Judging from the rapidly increased production in that country, now about 30,000 tons per annum, in the gradual improvement of quality and increased range of products, it is certain that it has proved, with all its basic faults, an advance on the long road towards the production of high quality engineering structures.

The backwardness in adopting presses more widely in this country may be due to economic stringency, but it may also be related to too rigid adherence to the idea of apparent cheapness of the no-pressure technique.

Hazards

I now come to the question of hazards in this industry which, while far less hazardous than many other sections of the chemical and certain aspects of the plastics manufacturing industry, must be faced and tackled in the manner employed in the latter industries. In a sense it is as well to exaggerate them rather than to belittle them. I assure you that in the early 1950s the chances taken by enthusiastic amateurs and other untrained workers were quite horrifying to a chemical engineer or other knowledgeable worker, involving as it does styrene monomer, highly inflammable, polyesters which can be dermatitic and organic peroxides and cobalt naphthenate which can prove explosive. Hazards such as silicosis due to glass appear to be small.

Two little has been printed or said about the hazards to plant and personnel but only if there is full understanding can a hazardous process be translated into a safe one. Safe plant, safe buildings (including segregations of mixing) proper clothing, adequate washing facilities and routine inspection is the way to it.

Is the picture as gloomy as I seem to have painted it ? I am sure it is not; experienced users have seen the basic value of reinforced plastic structures and know of the short-comings. My greatest concern is almost solely confined to the wet lay-up process using glass fibre mat and the even looser forms. Perhaps I am aiming too high and you can prove you are making large numbers of satisfactory parts for lorries or even complete bodies. I say they could be made better, for you cannot yet guarantee them as you can with steel or aluminium. Of first importance at the moment is the training of workers at every level and luckily this is being recognized more widely and one school has been operating for a year or so.

One day it will be possible to employ scanning methods to evaluate efficiency of impregnation by perhaps colour, by electrical, ultrasonic or other means. It may well be that pre-mixing, that is mixing the components prior to laying on the mould, will prove an answer. The aim must be perfect adhesion between resin and glass. Therein lies the secret of strength. It may be the answer also to improved self-colouring.

Perhaps the most important fact to you, irrespective of what I have said, is that numbers of motor cars and lorry sections are being made and sold and many are proving "satisfactory" on the road as will be seen from the slides at the end of the lecture. You will, I hope, indeed, you must, keep case histories of their road-lives and report in due course, to your technical journals. We must know more about their ageing characteristics.

So far as costs are concerned you will be interested in facts

about your own industry. The table below gives comparative figures with aluminium.

FIGURES FOR RELATIVE COST*

	Reinforced Plastics		Aluminium	
	Price	Weight	Price	Weight
	£ s. d.	lb.	£ s. d.	lb.
Front dome	6 9 0	30	13 5 0	40
Front wheel box	2 5 0	12	4 5 8	21
Rear dome	8 5 8	39	15 14 6	62

Finally the Bristol Aircraft Co., Ltd., have announced the latest stage of their original work (first published in 1955) in which by the use of closed moulds holding glass fabric and pumping or injecting the liquid resin into it, a thorough dispersion throughout the fibres is claimed together with complete absence of voids. This must prove to be a means of making high-duty structures and is therefore quite clearly the greatest advance made to date. It seems also to be the road to mass-production.

Summary

As I have already said, we have arrived at the period of second thoughts and some of the results appear to be as follows:—

(1) That the process must be regarded as a highly technical one, involving chemical and physical changes and therefore must be carried out in a well-controlled highly technical manner to achieve best results.

(2) That mass-production in the normally accepted sense is not possible in the economic or technically-worthy sense when using the wet " lay-up " process and no pressure. Thereby mass-production of ordinary low-cost motor cars is out of the question.

(3) That production *with* pressure gives a higher standard of impregnation and therefore more consistent properties throughout the structure. Thus high production and good quality components of small size have been produced by using matched moulds and pressure.

(4) That the final aim of an industry making medium-high quantities of commercial vehicles should be to employ preformed components followed by pressure to attain high impregnation and to eliminate the high labour costs of the lay-up process. Modern industry cannot afford hand-labour.

(5) That methods of " scanning " to evaluate efficiency of impregnation by colour change, electrical or ultrasonic methods, be evolved.

(6) That we know little or nothing about the " ageing " properties of the structures. Manufacturers could help with concerted efforts to obtain genuine case-histories of failures as well as successes.

* H. V. Blake (Fibreglass Ltd.) obtained from the Birmingham and Midland Motor Omnibus Co.

Safety Procedures in the Reinforced Plastic Plant

By J. ROBERT McCULLOUGH*

We have pleasure in reprinting the following notes recently published in the Journal of the Society of Plastics Engineers of America on a subject that has never been discussed seriously in public in this country. In view of our own long expressed remarks on its importance and because we believe that such discussion reflects the strength of the industry, we bring it to our readers' earnest attention.

IN our plastics division we work with both the polyester and the epoxy resins; therefore, we have both fire and toxicity hazards. With the polyesters the prime hazard, of course, is the fire hazard with a minimal toxicity hazard. Conversely, with the epoxies dermatitis is our prime consideration although the fire aspect cannot be completely ignored.

Our control of these problems starts long before hazardous materials ever reach our plant. A formal procedure has been established whereby only those hazardous materials as already approved for a specific use and appearing on a " Hazardous Materials List " may be purchased. This list was originally compiled by the safety department and any materials to be added to this list must be reviewed by us from a standpoint of both fire and toxicity and are then approved or disapproved for purchase. It is the responsibility of the safety department to keep this list active and up to date.

When these materials arrive at the plant they are placed in an isolated storage area under rigid control so that even though some difficulty might be had with them, they are away from the general plant, its personnel and its activity.

The amounts of these materials which may be brought into the general plant area are specifically limited in quantity and in no case do we permit more than a single day's supply of material to be brought into the working shops.

These procedures make it possible for us to know how much of what materials are in the plant and for what purpose so that we cannot get into difficulty from sheer ignorance.

Reinforced Hand Layups

Our primary use of polyester resins is in hand layups of this material reinforced with glass-fibre mat. The resin mix itself as well as the monomers and accelerators used with it range from " explosive " for cobalt naphthenate and methyl ethyl ketone peroxide down to " inflammable " diallyl phthalate. While some people may be sensitive to the action of the glass-fibre mat and some others may be sensitive to styrene or even polyester resins we think of these as isolated cases which can be easily handled and concentrate our effort on fire prevention.

All of these ingredients are handled and mixed by trained specialists in an explosion-proof room. Not only are these mixes prepared in this room, but the closed tank systems employed in spraying the material are also charged in this room and delivered by the mixing technician to the point of fabrication. At this point of fabrication giant exhaust hoods are used to draw over-spray out through a system of glass-fibre filters to the outside air. The volume is so great that a make-up system has had to be installed on the opposite side of the room. The operators on this work are provided with cover-alls and rubber gloves to completely protect the body from contact with the material. It is also of interest that in conjunction with our plantwide 100% eye protection programme that these people also wear eye protection. Also in this fabricating area complete fire protection is afforded with sprinkler systems, chemical fire extinguishers, deluge personnel showers, and fire blankets. It goes without saying that smoking is not permitted in the area.

Overcoming Small Fires

We have occasionally had small fires due to the exotherm of unreacted trim material which had been thrown into waste cans in quantity and then " kicked over " in the can. This was overcome by reducing the size of the waste containers and by removing them more frequently.

On the basis of this control we have been working with large quantities of polyester materials for several years and have not had any serious problems.

Epoxy resins are used where bulk, rigidity and dimension maintenance are important. As compared with polyesters activity, our only fire concern is with acetone, and with the

* The Budd Company, U.S.A.

control programme as outlined in conjunction with the polyesters we have managed to stay out of trouble. With toxicity, however, or to be more specific, with dermatitis, we have not been quite so fortunate. We have attempted to keep up to the minute in this field and we feel that we have had as much success as anyone in the field but it is a fact that we have had some dermatitis difficulties.

People who work with this material are given a physical examination prior to entering the department. Persons with known skin sensitivities or already afflicted with one form of dermatitis or another are naturally eliminated. There are some sources that advocate patch testing at this point but there are many and divergent opinions as to the effectiveness of patch testing and we are among those who consider that it still leaves much to be desired. We know that these materials, and primarily the amine hardeners, are both basic irritants and sensitizers, that their resultant defection is a contact dermatitis and we seek to prevent the contact. We provide personalized cover-alls and by personalized I mean that several pairs are assigned to each employee so that he is always wearing one pair of his own while the other one or two pairs are being laundered. These cover-alls have detachable sleeves which are an expendible item. We have used a light-weight duck but are currently experimenting with a disposable paper. We also use a close fitting rubber glove that is rugged enough for the work involved yet light enough to permit setting and forming with the fingers.

Additional prophylactic measures are taken such as separate lockers and toilet facilities for plastics workers; double lockers, one for street clothes and one for work clothes; protective creams of which we have tried dozens. Also special waterless soaps are supplied and the use of acetone on the skin is forbidden. Our effort obviously is not only to prevent contact with these irritants but to remove as little as possible the natural oils and protective horny surface of the skin. To further control this material a separate mixing room similar to the one for polyester work is maintained but for a different reason. Here an experienced employee, who over a period of the last five years has shown himself either through personal cleanliness or a natural resistance to have proven impervious to the irritating effects, mixes and supplies the basic resins for the manufacturing processes and gives them to the floor mechanics in the quantity and condition ready to apply to the job. It minimizes the employee exposure.

Hand work on these build-ups begins while the material is actually partially cured although we refer to it in shop terminology as being in the cured state. To minimize hazard here we again fall back on a giant octopus of an exhaust system which, while it does not move the volume of our polyesters exhaust, does filter the air and remove toxic and/or irritating dusts from the work area.

Isolated Outbreaks

With the extensive effort that we have made to control the use of this material one would think that we should be completely trouble-free. The fact of the matter is that while we have minimized our difficulties we still have isolated outbreaks of industrial dermatitis. What then is our outlook towards complete eradication of this difficulty?

First, we must look to you people of the plastics engineers group to find harmless materials to do the same work. We have but recently changed in a large part to a supposedly minimal irritating hardener. As yet it is too soon to state any concrete results but we feel that in this direction lies the ultimate complete solution even if it means overhauling the entire chemical structure of the process.

Another very important phase is in continuing to sell to the production people the idea that personal cleanliness is the most important key to the control of this dermatitis. It is a difficult situation because the average man thinks you are calling him dirty when you talk about personal cleanliness. Yet, every text that I have been able to read on industrial dermatitis stresses personal cleanliness as the most important factor in its prevention.

LETTERS TO THE EDITOR

(See also page 48 of this issue)

Plastics and Commercial Vehicles

SIR,—Having successfully completed over 100 commercial vehicle bodies in a variety of pigmented reinforced plastics, I was interested in Mr. H. V. Blake's remarks to the effect that nearly all mouldings used in road vehicles are painted. (*Plastics*, January, 1957, pages 18–20.)

The reason given by Mr. Blake, that deep scratches in laminates cannot be adequately dealt with, is wholly disputable; even in painted vehicles, how many commercial owners effect a " local " repaint for every mark that is gathered during the service of the vehicle?

The real clash of paint against a pigmented vehicle comes to its head when the vehicle is due for one of two things, after a certain length of service, that is, does it need repainting, or can the pigmented gel-coat be revitalized to enable it to compete with a repaint, but at much less cost.

My experience answers this question in the affirmative, but it is, of course, essential to have a first-class moulding from the beginning, and probably one of the main reasons for the slow advance of pigmented plastics in the body-building industry as a whole is the inability to produce a quality finished product.

Also, as Mr. Blake states, aluminium is 100 years old, and no industry changes its materials over-night; but the impact of reinforced plastics, whether pigmented or not, has at least made itself felt in the body-building industry.

L. E. HICKS.

Plastics Supervisor,
Commercial Body Builder.

Polythene Sprinkler

SIR,—We are trying to find the manufacturers of a graduated powder sprinkler made in polythene of 6 oz. capacity. Unfortunately, the sample has left the writer's hands but it is thought that the name " Kenton " or something similar was moulded on the bottom. If you are able to assist us on this point, it would be greatly appreciated.

DORMEX DEVELOPMENT CO., LTD.
96 Rusholme Road,
Manchester, 13.

Cistern Float

SIR,—Can you please tell us if there is a cone-shaped cistern float on the market, in plastic material?

STANLEY SHAW & CO.
141 Falsgrave Road,
Scarborough,
Yorkshire.

Plastics for Table Lamps

SIR,—Could you please inform me of the names and addresses of the manufacturers of the following:—(1) Plastic balls (solid) about 1 in. in diameter in a range of colours suitable for incorporation in a range of modern table lamps. (2) Decorative plastic sheet suitable for lamp shades?

J. E. RAWNSLEY, A.M.I.E.E.
" Warde Croft,"
Renton Avenue,
Guiseley,
Nr. Leeds.

U/V Filters

SIR,—We wondered whether any of your manufacturer readers have ever considered exploiting the use of high density polythene and colour pigments to the extent of being able to manufacture Ultra Violet filters.

We understand that a plastic type of U/V filter is available on the Continent, but the only type we can obtain is the black glass type.

If you know of any such manufacturers we shall be pleased to have details.

Can you also give us the addresses of manufacturers who can supply fluorescent acetate sheeting?

W. C. M. BROWN.

Bevis Electronics,
87a Bevis Road,
North End,
Portsmouth.

Plastics in the Oil and Chemical Industries

By M. A. MATTHEWS,* Ph.D., D.Sc., F.R.I.C.

The following excerpt is taken from a paper read at the 1956 Convention of the Swedish Plastics Federation, and is reprinted by agreement with the Federation. The section of the paper we publish here deals with the contribution of plastics piping to the oil and chemical industries

In introducing the paper, the author reviewed the growth of the chemical, oil and plastics industries. In the case of oil, the rate of growth is about 5% per annum, and it is anticipated that by 1975 the annual rate of oil production will be 2,100 million metric tons. It is anticipated that the chemical industry will grow at the average rate of at least 5%, and the 1975 output may be estimated at 250–300 million metric tons. The plastics industry growth rate is computed to be about 7%, yielding an output by 1975 of 8 million metric tons. It is against the background of these figures that the author discussed the use of plastics by the oil and chemical industries, and in the excerpt which follows, he treats in some detail, the contribution of plastic pipes. According to a U.S.A. source, approximately 10% of the chemical industry's capital expenditure in 1975 (£1,700 million) will be in piping, valves and fittings. Assuming that 15% of this business could be filled by plastics, our industry could contribute about £25 million of the capital investment in the chemical industry for this one use.

THERMOSETTING and thermoplastic resins are both used as materials of construction in the oil and chemical industries; the latter, however, by virtue of their greater ease of fabrication are finding by far the greater application. In Table 1 a list is given of the thermoplastic resins which are important in this field, together with their principal physical properties.

Polyester resins and epoxy resins, although thermosetting, do find important applications in plant construction however. This is because they can be cured without application of pressure and because when reinforced with glass fibre they combine lightness with strength and also possess considerable resistance to chemical action. Other thermosetting resins are used for corrosion-resistant cements and for coatings.

The applications of plastics in the oil and chemical industries can be conveniently classified under three main headings:—

(1) Plastic pipe. (2) Plastic vessels and plastic lined vessels. (3) Surface coatings. (4) Miscellaneous applications.

* Shell Petroleum Company, Ltd.

Plastic Pipe

As might be anticipated, one of the main uses for plastics in the oil and chemical industries is in the form of pipe. Monsanto (1) have estimated that the potential applications of plastic pipe in the U.S.A. chemical industry in 1954 would amount to 1.4% of the total capital expenditure in that industry. They predict that by 1975 the annual demand for plastic pipe will be 300 million lb./year. This quantity is best visualized as a continuous tube 1 in. bore × ¼ in. wall thickness of specific gravity midway between that of p.v.c. and polyethylene (two of the most important plastic materials for pipe manufacture): such a tube would reach from the earth to the moon (a distance of approximately 250,000 miles). The chief markets for plastic pipe are regarded as the petroleum industry, sewage and waste disposal, public utilities and the chemical industry, the latter alone accounting for 50 million lb./year.

According to another source (2) the sales of plastic pipe in the U.S.A. were as follows:—

Year.	*Millions lb.*
1950	5
1954	30
1955 (est.)	37

The breakdown in 1954 was as follows:—

	Millions lb.
Polyethylene	18
Styrene-butadiene-acrylonitrile	4.5
Cellulose acetobutyrate	4.5
P.v.c.	1.0
Miscellaneous	2.0

The above figures compared with metallic pipe production in 1954, close to 9 million tons of ferrous pipe alone, are very small. However the growth from 1950 to 1955 is notable and may be an indication as to future prospects.

The fabrication of plastic pipe from thermoplastic material is relatively simple and is carried out by the well-known extrusion process for diameters up to the capacity of the machines available. Above these diameters other techniques have to be employed. For example polyethylene pipe of diameter up to 3 ft. can be made by a centrifugal casting process in which the molten resin is applied to the inner wall of a heated rotating steel pipe and then allowed to cool and solidify with the pipe, from which it is subsequently withdrawn.

According to the material used the pipe may vary between flexible and rigid. Thus plasticized p.v.c. will give a flexible tube which is useful as hose and for flexible connections and may have a steel wire incorporated in helical fashion in the pipe wall to increase the strength and resist flattening. Polyethylene manufactured by the conventional high pressure process gives pipe which has inherently a moderate degree of flexibility and this enables it to be coiled up on drums in a manner similar to electric power cable. This is very advantageous as it permits considerable lengths to be handled conveniently. Pipes made of rigid plastics, e.g. unplasticized p.v.c. on the other hand, cannot be treated in this way, though their lightness permits them to be handled far more easily than steel pipe of comparable size.

As regards jointing of contiguous lengths, a variety of methods is available for plastic pipe. Pipe extruded from thermoplastic material may be welded by a special torch using a jet of heated gas, e.g. nitrogen for polyethylene and air for rigid p.v.c. Alternatively the ends may be cemented or welded into sleeves of the same material and other special methods of jointing are used, e.g. solvent welding in the case of p.v.c. which cannot be done, however, in the case of polyethylene. Owing to its flexibility pipe made of ordinary polyethylene can be laid in long runs without joints as it is uncoiled from the drum.

Moulded plastic fittings, e.g. ells, tees, etc., can be used in conjunction with the pipe; or where corrosion is not a problem cast metal screwed fittings can be used with plastic pipe which is capable of being screwed externally. The latter may, of course, also be jointed by the use of screwed steel flanges.

Two points of great importance in deciding the suitability of plastic pipe for any given application are the working pressure requirements and the temperature. At any given temperature the tensile strength of rigid p.v.c. for instance is far greater than the permissible hoop stress in the pipe wall at that temperature. This is because at stress values even well below the ultimate tensile strength creep takes place with a gradual weakening of the pipe. This tendency to creep is more pronounced the higher the temperature, and for this creep to be insignificantly small the so-called "long-term" tensile strength of the material must not be exceeded; this is less than the ultimate tensile strength value as ordinarily measured, particularly at higher temperatures. Table 2 shows how the "long-term" tensile strength of p.v.c. falls off with increase in temperature.

In general, plastic pipes can only be recommended for working temperatures up to about

TABLE 1

PHYSICAL PROPERTIES OF SOME IMPORTANT THERMOPLASTIC MATERIALS

	Sp. Gr.	Heat Distortion Temperature (0° C.) (A.S.T.M. D.648)	Tensile strength (p.s.i.)	Elongation %	Impact Strength (ft. lb. per inch notch)	Thermal Expansion 10^{-5} per °C.
Polyethylene* (Low-pressure)...	0.96	74–79 (66 p.s.i.)	4,000–4,500	20–30	3.0	—
Polyethylene (High-pressure) ...	0.92	40–50	1,500–1,800	200	16	16–18
P.V.C. (rigid)	1.35–1.55	60–85	5,000–9,000	5.0–15.0	0.4 –20	5–6
Polystyrene	1.04–1.065	71–99	5,000–9,000	1.0– 3.6	0.25– 0.50	6–8
Polystyrene (high impact) ...	0.98–1.10	65–93	3,500–6,500	10–90	0.5 –11.0	3.4–21
Nylon	1.14	182 (66 p.s.i.)	10,900	90	1.0	10
Acrylonitrile/styrene copolymer	1.01–1.10	70–90	3,000–6,000	Up to 50	0.4 – 9.0	6–13
Cellulose acetate butyrate ...	1.15–1.22	46–93	2,600–6,900	40–80	0.8 – 6.3	11–17
P.T.F.E.	2.1 –2.3	132 (66 p.s.i.)	1,800	110	4.0	10

Taken from Plastics Properties Chart—"Modern Plastics" Encyclopædia Issue, 1954.

* Phillips "Marlex" 50—taken from "Industrial and Engineering Chemistry," July, 1956, page 1156.

TABLE 2

LONG-TERM TENSILE STRENGTH OF P.V.C.

° C.	0	15	20	30	40	60
Long-term tensile strength (Kg/cm^2)	260	205	187	151	114	41

60–70° C., which admittedly limits their usefulness but still leaves open a wide field of application.

It is of interest to compare plastic pipe with steel pipe from the point of view of cost. In such a comparison several factors have to be taken into account other than the cost per lb. of the material. Steel pipes of small diameter have to be made of much greater wall thickness than is required by the pressures they usually have to withstand; this is because allowance must be made for external screw threads and also for corrosion. Thus, a steel pipe of 1 in. internal diameter to withstand pressure up to 150 p.s.i.g. theoretically only needs to have a wall thickness of about 0.005 in. Such a pipe would be very difficult to manufacture and would have no advantage pricewise over the standard wall thickness, apart from the fact that it would in any case be quite impractical.

In view of the higher price of plastics in comparison with steel, it is desirable and usually practical to restrict the wall thickness to the required minimum. This offsets the price disadvantage, since as already pointed out, steel pipes usually must for purely practical reasons have wall thicknesses much greater than theoretically necessary.

Table 3 compares the cost of steel pipe with

TABLE 3

Material	Bore and Wall Thickness	Price per foot	Working Pressure p.s.i.
		s. d.	
Mild steel	app. 1 in. x $\frac{1}{8}$ in.	1 9	500
Polyethylene (HP)	1 in. x $\frac{1}{8}$ in.	1 6	80
Rigid p.v.c. ...	1 in. x $\frac{1}{8}$ in.	1 3	180
Rigid p.v.c. ...	1 in. x $\frac{1}{16}$ in.	8	90
Cellulose acetate-butyrate ...	1 in. x $\frac{1}{8}$ in.	2 2	240
Cellulose acetate-butyrate ...	1 in. x $\frac{1}{16}$ in.	1 4	120
Cellulose acetate ...	1 in. x $\frac{1}{8}$ in.	1 6	150
Nylon	app. 1 in. x $\frac{1}{8}$ in.	5 0	500
Nylon	1 in. x $\frac{1}{16}$ in.	3 0	250
P.T.F.E.	1 in. x $\frac{1}{8}$ in.	42 0	100
Polyester/glass ...	app. 1 in. x $\frac{1}{8}$ in.	11 0	500
Polyester/glass ...	1 in. x $\frac{1}{16}$ in.	7 0	200
Polystyrene ...	1 in. x $\frac{1}{8}$ in.	1 4	250
High impact polystyrene ...	1 in. x $\frac{1}{8}$ in.	1 4	180

that of various plastic pipes now produced commercially or experimentally in the U.K. on the basis of 1 in. bore and $\frac{1}{8}$ in. wall thickness. For plastics having high tensile strengths additional prices have been listed for pipes of thinner walls.

It is obvious that for general application in, for example, cold water services, only pipe made from the cheaper plastics would be competitive with steel. The more expensive plastic pipes find their application in specialized applications where cost is a secondary factor. Also, in any practical comparison the data quoted in Table 3 must be considered along with many other factors, e.g. impact strength, heat distortion temperature, etc., as given in Table 1.

The majority of the plastics listed in Table 3 are not yet in commercial application in piping systems of any size or complexity in the U.K. Therefore a more detailed comparison has been restricted to pipes of polyethylene (H.P.), rigid p.v.c., cellulose acetate-butyrate and mild steel. Table 4 lists the current prices in the U.K. of 2 in. bore pipes and gives the material cost for 100 ft. length of the piping, together

TABLE 4

MATERIAL ONLY—COSTS PER 100 FT. RUN 2 IN. BORE PIPING

	Cost per foot	Cost of Material per 100 ft.	Jointing Requirements
	s. d.	£	
Polyethylene	4 5	22	No jointing required
P.V.C. (Rigid) ...	2 5	12	Sleeving and cementing required
Cellulose acetate-butyrate ...	4 5	22	Sleeving and cementing required
Mild Steel ...	2 2	11	Welding, flanges, etc., required

with jointing requirements. Polyethylene piping of this diameter can be purchased coiled in a full 100 ft. length and thus no jointing would be necessary. In all cases the pipes would withstand at least 50 p.s.i.g.

It will be appreciated that an important factor in the cost of any pipework system is the cost of installation, and therefore any useful comparison must include, in addition to basic pipe cost, the cost of fittings and the labour cost.

For the purpose of a practical comparison a simple piping layout has been considered, as follows. Two 50 ft. 1 in. service pipes are fed from two 20 ft. 2 in. mains, which are in turn fed from a 20 ft. 4 in. main. The required parts of this system are:—

20 ft. of 4 in. pipe.
40 ft. of 2 in. pipe.
100 ft. of 1 in. pipe.
Two tees, 2 in.–1 in.
Two tees, 4 in.–2 in.
Necessary flanges and joints.

Pipes considered are 1 in. bore, 2 in. bore and 4 in. bore of wall thicknesses to give working pressures of not less than 80, 50 and 40 p.s.i.g.

Table 5 shows the estimated cost of installing (but not trenching and burying) such a system

TABLE 5

	Polyethylene	Rigid p.v.c.	C.A.B.	Mild Steel
Basic piping costs	£25	£15	£33	quoted
Fitting costs ...	£7–10	£15	£10	£50
Labour cost ...	£7–10		£5	together
Total	£40	£30	£48	£50

in the materials being considered, from which it will be seen that all three plastic materials compare very favourably with mild steel in cost.

A further factor of importance in a cost comparison is the maintenance cost. Here again the plastic pipes would have a number of advantages over steel, viz.:—

(i) There is no need to paint plastic pipes. They can be produced in various colours to suit requirements.
(ii) In cold water and salt water service steel pipe corrodes and requires eventual replacement; plastic pipe does not.
(iii) There is far less risk of bursting through frost action in the case of plastic pipe.

On the other hand, subjection of plastic pipe to heavy impact must be guarded against, particularly at low temperatures at which the pipes become more brittle. Due to its tendency to sag plastic pipe needs more support than steel if installed overhead. Thus rigid p.v.c. pipes should be supported at not more than 6 ft. intervals for 1 in. pipe and 3 ft. intervals for 6 in. pipe. Polyethylene pipe should preferably be continuously supported. Another factor to be borne in mind and allowed for is the very much greater coefficients of expansion for plastics as compared to steel. For a given temperature rise p.v.c. will expand to about six times the extent of mild steel and polyethylene about 15 times.

Regarding the application of plastic pipe in the oil industry, p.v.c. would seem to be the most promising candidate. In oil exploration work a valuable tool in the hands of the geologist is the seismic technique. This involves drilling a hole some 100 ft. deep, known as the shot-hole, and exploding a dynamite charge at the bottom. Seismometers located at various points pick up the shock waves reflected from the interface between the different rock strata or else measure the difference in speed of the waves through the different strata. From such information it is possible to compute the most likely position of oil-bearing formations.

The lining or casing of the shot-hole has been carried out hitherto with 3 in. I.D. steel tubes in 10 ft. lengths. This tube is re-used where possible, but recovery is often made impracticable by "cauliflowering" of the lower end of the tube by the firing of the shot. Tests have been made with p.v.c. tube and it has been found that the lower end is shattered by the explosion and cut off cleanly, so making it much easier to withdraw the remainder for re-use. In this application the p.v.c. pipe sections may be joined by a male and female thread.

Another important potential application for p.v.c. or polyethylene pipe in exploration work is in the construction of water lines for the provision of drinking water for the camps.

It will be realized that more often than not, oil is awaiting discovery in the most remote and inaccessible places. A considerable item in the cost of exploration is the cost of transport of supplies to the exploration site, which often can only be achieved by helicopter. Owing to its lightness in comparison with steel, p.v.c. or polyethylene pipe can make a contribution towards lessening this cost.

In conjunction with producing oil wells p.v.c. pipe finds further uses. For instance it can be used for secondary lines conveying crude oil from the main line to tankage, since in these secondary lines the temperatures and pressure are under control. Plastic pipes have an advantage over steel for this purpose in that the inner surface is much smoother and there is much less tendency for paraffin to accumulate in consequence.

Some wells produce salt water along with oil and the mixture is first separated by gravity separators. P.v.c. pipes may advantageously be used to lead away the salt water, since steel pipes in this application would be subject to heavy corrosion unless protected in some way. In the above applications cellulose acetate-butyrate and styrene copolymer pipe has also been reported successful (3), (4).

An interesting possibility in connection with the application of plastic pipe in remote sites is the use of mobile extruders. These machines would extrude the pipe as required on site so that, instead of pipe, plastic powder

would be shipped, which would occupy far less space.

Let us now consider the possibilities for plastic piping in a refinery. The total length of installed pipe for a European refinery with a throughput of 2 million tons per annum is about 560 kilometres (350 miles), and 50% of the total installed pipe is 6 in. and 8 in. diameter. Although it is unlikely that plastic pipe will find anything like general use in refineries on account of fire risk, it is quite feasible that it may be applied for water lines.

Passing to the distribution of petroleum products, the chief potential use of plastic pipe is as flexible tubing for making temporary connections during loading and unloading road and rail tankcars. P.v.c. plasticized with polymeric type plasticizers is the most generally applicable material in this respect and would replace canvas reinforced rubber hose in this application. P.v.c. hose may be reinforced with canvas and armoured with a helical steel wire embedded in the tube wall. In this way the tube combines good flexibility with strength.

For crude oil and most petroleum products, e.g. gasoline, gas-oil and kerosine, natural rubber and GR-S are unsuitable and special oil-resisting synthetics have to be used, e.g. nitrile rubber and neoprene. These latter are much more expensive types of rubber and are dearer than plasticized p.v.c. It has to be borne in mind, however, that flexible tube for these applications has to be canvas reinforced and wire armoured whether it is synthetic rubber or p.v.c., and this, together with the necessary end fittings accounts for a considerable part of the cost of the hose.

For petroleum chemicals and organic chemicals in general, plasticized p.v.c. has to be used with caution in view of the possible solvent action of the chemical for the resin and/or plasticizer.

In the chemical industry plastic pipe finds many uses of a specialized nature where outstanding chemical resistance is more important than price considerations.

A good example to illustrate this point is the application of polytetrafluorethylene (p.t.f.e.) pipe. The resin itself is very costly (current U.K. price approximately £3/lb.) and it is only recently that means have been found to fabricate it into pipe since extrusion processes cannot be used; instead a method analogous to powder metallurgy techniques has to be employed. Owing to the unique chemical inertness of p.t.f.e. and its ability to withstand temperatures up to about 250° C. (in the absence of stress) this pipe can be used in special applications involving the handling of strong acids, corrosive chemicals and the like.

The chemical resistance of various plastics used for pipe is compared in Table 6. From this it will be seen that plastics are available to meet many requirements. Most thermoplastic materials, however, are not suitable in the form of pipe for temperatures greater than about 50° C. For higher temperatures up to 100°—120° C. pipe made of polyester/glass fibre or epoxy resin/glass fibre may be used, though these pipes are in the development stage as yet, and must be used with caution for applications involving pressure.

Among the many varied uses of plastic pipe in the chemical industry may be mentioned the use of polyethylene pipes for effluent disposal. These can be made in large sizes, as previously mentioned, by the centrifugal casting technique.

TABLE 6
CHEMICAL RESISTANCE OF SOME PLASTIC MATERIALS

Plastic	Chemical Resistance
P.v.c.	Swells in ketones, esters, aromatic hydrocarbons. Dissolves in alcohols.
Polystyrene ...	Attacked by oxidizing acids. Soluble in aromatic and chlorinated hydrocarbons.
Polyethylene ...	Attacked by oxidizing acids. Soluble in aromatic solvents above 60° C.
Polyamides ...	Attacked by strong acids. Resistant to most common solvents.
Cellulose acetobutyrate ...	Decomposed by acids, alkalis. Soluble in ketones, esters, etc. Only little affected by hydrocarbons.

Acknowledgment

The author wishes to express his thanks to Messrs. W. H. Reay and S. Squires for their assistance in the preparation of this paper.

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2. *Chemical and Engineering News*, July 25, 1955.
3. *Chemical Week*, May 22, 1954, p. 96.
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The Thermal Conductivities of Resin/Glass Laminates

By E. H. Ratcliffe

Communication from the National Physical Laboratory, Teddington.

SEVERAL determinations of the thermal conductivities at 95° F. of resin/glass laminates of various types have been carried out at the Laboratory; these have included laminates containing polyester, phenolic, melamine and silicone resins. All measurements were made on pairs of 3-in. diameter discs of the laminates, each about ¼ in. thick. The apparatus used consisted of a flat circular metal hot-plate containing an electrical heater, and a pair of water-cooled cylindrical metal cold-plates. The plates, which were also of 3-in. diameter, were mounted horizontally, with the specimens placed one on either side of the hot-plate, the whole assembly being clamped between the two cold-plates, and lagged with insulating material. Temperatures were measured by means of thermocouples in the plates, and the energy input was measured electrically. Thin films of fluid, such as glycerine or silicone oil, were used to displace any air films between the discs and plates, and thus to reduce the temperature drop between the surfaces of the plates and of the specimen. A small correction was applied for this drop, and also for heat loss from the edges of the apparatus.

Results

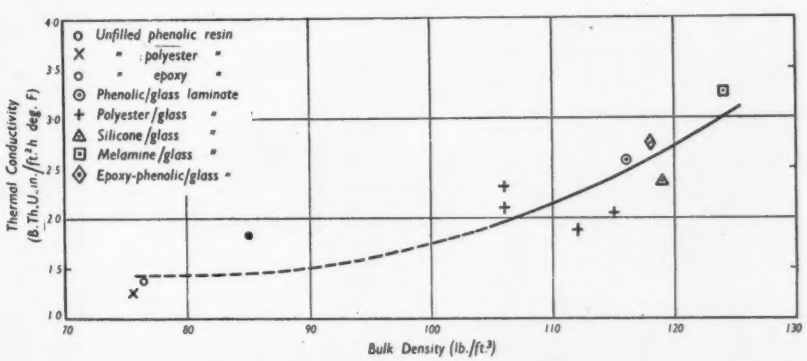
The results obtained are displayed on the graph and show some correlation between thermal conductivity and bulk density, although departures from the curve shown can be of the order of ±15%, due to different manufacturing methods, the number of glass fabric fibres per unit thickness of laminate (which may tend to carry voids and reduce the conductivity, whilst increasing the bulk density), the type of fabric, and also the conductivity of the resin itself. However, the predominant factor appears to be bulk density, assuming that the laminates are reasonably free from voids; and a change of resin does not cause as much departure from the curve as might be anticipated, since the high conductivity of the glass reinforcement has a marked effect.

A recent paper (1) gives conductivity data over the range 200° F. to 500° F. for polyester/glass laminates; but the very low values obtained are open to doubts. The authors indicate that excessive air voids or warpage during test may have affected the results.

The work described above has been carried out as part of the research programme of the National Physical Laboratory, and this memorandum is published by permission of the Director of the Laboratory. The author desires to acknowledge the assistance rendered by Miss P. A. Lindsey, who carried out the measurements.

Reference

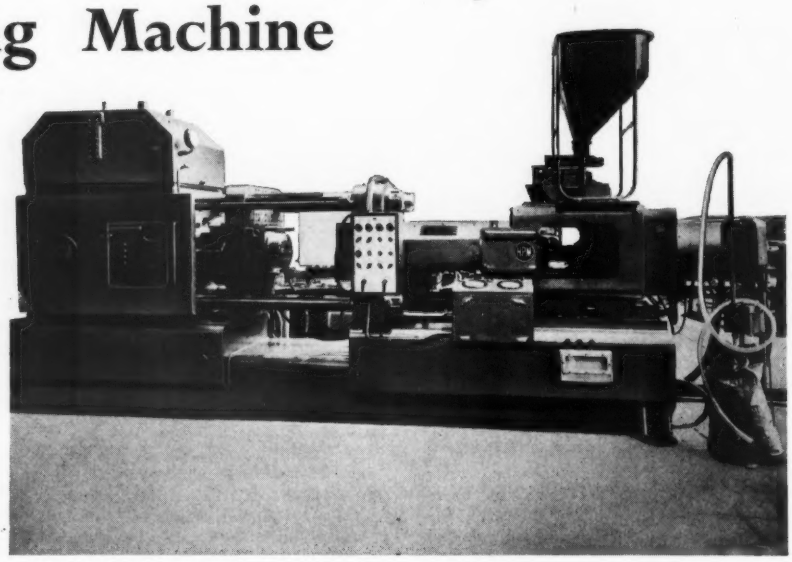
1. F. R. O'Brien, Sabert Oglesby, Jr., and P. C. Covington: "Thermal Properties of Laminates," *Modern Plastics*, Aug., 1956, p. 158.



Thermal conductivities of laminates—showing some correlation between thermal conductivity and bulk density, at 95° F.

The H.P.M. 400-H-20 Injection Moulding Machine

We give here details of the first British-built H.P.M. injection moulding machine. The machine is being built by Cravens of Sheffield for Wickman Ltd., and incorporates many new and interesting features which will commend it to moulders.



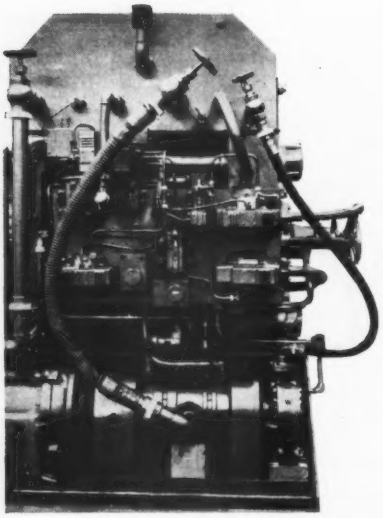
ALTHOUGH the H.P.M. has been available for some years to the British plastics industry it is only now that a fully British-built machine has been produced. This machine, which is being built by Cravens of Sheffield and distributed by their associates, Wickman Ltd., Fletchamstead Highway, Coventry, is the 400–H–20 20 oz. machine and will be the forerunner of at least two others, the 300–H–12 and 800–H–48 of 12 and 48 oz. capacities. A smaller machine will probably be made at a later date.

The 400–H–20 has a nominal shot capacity of 20 oz. but this can be increased up to 26–28 oz. by using a double shot mechanism which is an integral part of the machine design. Other features of the basic design are the long stroke and daylight of the press, the latter being a maximum of 40 in., and the hydraulic system.

The operations performed by the press are variable and can easily be adjusted to suit varying conditions and materials. A typical moulding cycle employing the double shot is fast mould close followed by final slow close and pressure build up; injection cylinder forward followed by injection stroke of plunger; plunger retracts and makes second shorter stroke for injecting the second shot.

SPECIFICATION FOR THE 400–H–20 INJECTION MOULDING MACHINE

Weigh feed from hopper...	Up to 40 oz. or 200 cu. in./cycle.
Volume moulded per shot	34 cu. in.
Weight moulded per shot	20 oz. polystyrene, 24 oz. cellulose acetate.
With double stroke ...	28 oz. polystyrene, 34 oz. cellulose acetate.
Plasticizing capacity ...	200 lb. polystyrene/hr., 240 lb. cellulose acetate/hour.
Injection plunger	3⅞ in. diameter.
Pressure on material ...	20,000 p.s.i.
Stroke of injection plunger	12 in.
Rate of injection	20 cu. in./sec.
Size of die plates	36 in. × 42 in.
Space between bars ...	21 in. × 27 in.
Mould opening stroke ...	25 in.
Maximum die space ...	40 in. or 24 in. with spacer.
Minimum die space ...	15 in. or 9 in. with spacer.
Maximum projected area of mould	200 sq. in.–230 sq. in.
Mould locking force ...	400 U.S. tons, 360 long tons.
Capacity of hopper ...	100 lb.
Power consumption of heating units at full capacity	35.4 kW.
Minimum overall cycle time (without curing time) ...	15 sec.
Time taken for clamping on maximum stroke ...	5 sec.
Maximum travel of piston	25 in.
Time for opening mould ...	5 sec.
Backward time of injection plunger	4 sec.
Hydraulic oil needed ...	150 gall.



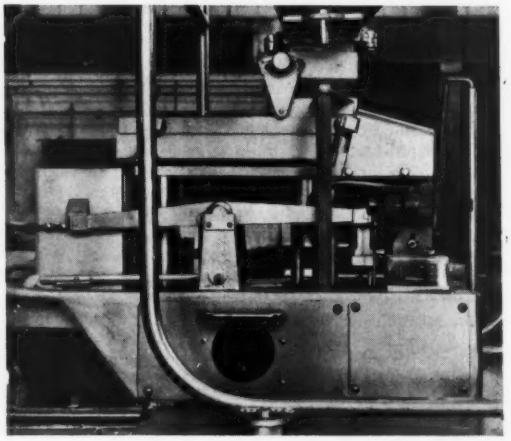
(Left) The manifold valve system at the mould locking cylinder end of the machine. The two hydraulic pumps can be seen at the bottom of the picture.

(Right) The weigh feed unit showing the oscillation control dial. The unit has been designed and built by Southall & Smith.

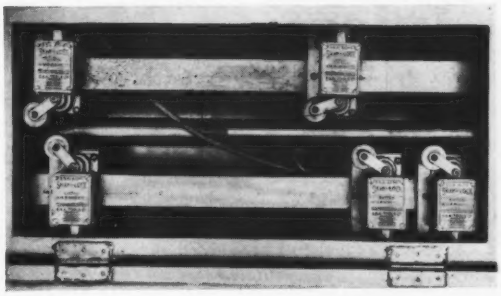
The plunger retracts again and then moves forward taking the next shot of powder into the heating chamber but exerting no pressure. The cylinder is withdrawn thus breaking the sprue and the mould is opened. Several of these operations can be dispensed with if they are unnecessary. For example, the movement of the injection cylinder for sprue breaking and the double shot motions can be cut out of the cycle.

The H.P.M. has two platens, one fixed and one attached to the mould closing ram which provides the locking force. The injection cylinder and feed chamber are mounted on ways and when fully retracted give easy access to the nozzle and allow the removal of the cylinder, which is held by a wedge lock, without hinderance. The material feed is by a compensated weigh feed unit designed and built by Southall & Smith of Birmingham. This unit incorporates a vibrating chute, the oscillations of which can be varied to suit the granular shape and size of the raw material. Provision is allowed for the feeding of runners and sprues by a run through.

The injection cylinder is heated in three zones by band heaters, the forward zone having nine bands and the other two zones six each for 440 volts. For 220 volts the number of



(Left) The heating and time cycle control panel. Details of this are given in the text on this page.



(Right) The mould locking ram control switches giving fast approach and return and slow locking and ejection. The switches are positioned by moving them along their supporting bar.

heaters is increased accordingly. The total power consumption of the heating units is 35.4 kW.

Hydraulic Mechanism

Power for the hydraulic system is supplied by a 50 h.p. electric motor driving two pumps, a high pressure pump of small output and a low pressure double pump of large and small output. The oil reservoir, which has a capacity of over 150 gallons, is situated above the mould locking cylinder and has a sight-glass and temperature indicator fitted, the latter operating automatically an oil cooling unit. Manifold mounted valves at the mould locking cylinder and injection cylinder eliminate a considerable amount of piping and are readily accessible.

For mould closing both pumps operate on a booster ram giving a fast closing speed until a limit switch directs the force over the full ram area giving a slower close and greater pressure build up. The double pump is then switched to the injection cylinder and operates the plunger primarily on a booster ram and then on the full area for the injection cycle. It is then switched to reverse the stroke and withdraws the plunger. For the retraction of the cylinder the high pressure pump can be switched from mould clamping and used on a separate piston and ram for this purpose. The mould clamp is meanwhile held on low pressure by a pilot valve. After the injection plunger has refilled the heating chamber and is at the prepositioned point, the high pressure pump reverses the mould closing ram and after an initial slow opening period is supplemented by the double pump to give the quick opening speed until near the end of the stroke, when the double pump is by-passed to the tank and final slow opening for ejection takes place.

Controls

The versatility of this injection moulding machine has not necessitated a complex and difficult control system. For operating under normal conditions it is semi-automatic, the closing of the guard initiating the sequence of timed cycles. A mould open timer and low pressure mould protection can be fitted for fully automatic operation.

The limit switches for the mould closing and opening ram are situated conveniently by the side of the ram and can be moved on a rail as required to give variable daylight and adjustment to the period of fast closing or opening. The switches are operated by a rod fitted to the platen. Limit switches working on the same principle but actuated by the injection plunger control its stroke and other functions.

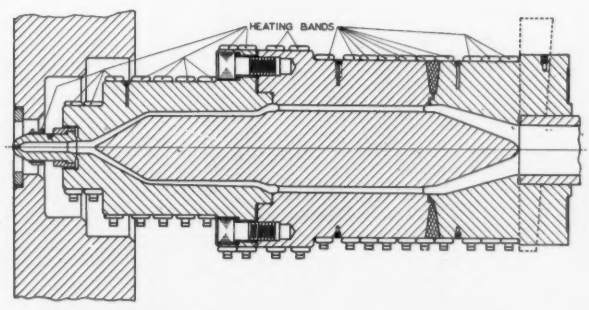
The high and low pressures for clamping and injection are shown on two dials on the front of the machine; beneath them are four control valves setting the pressures required. Three control valves and a sight glass for the water cooling system are situated conveniently below the hopper. The position of the ejection mechanism, which can be central, off-centre or both, is set by adjusting two hand wheels at the mould clamping end of the machine.

The operating controls are situated on a panel by the guard and consist of switches for control, heat, motor, and weigh feed. In addition there is a control for run through on the weigh feed unit and an emergency mould clamp reverse switch. At the bottom of the panel are adequate controls for "inching" when setting up the mould. This latter operation is considerably simplified as the clamp automatically adjusts for different mould thicknesses.

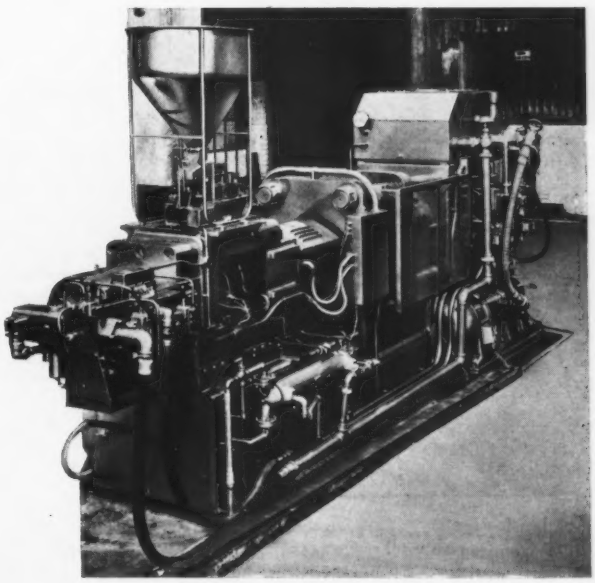
The heater controls and timers are situated in a separate cabinet. For the former Ether Wheelco controllers are used. The four timers set the cycle for mould clamping, the first injection shot, the second shot (when used) and the time on full pressure.

Conclusion

This injection moulding machine has been thoroughly tested both in the laboratory and under moulding shop conditions. The results of a study of the requirements of the moulder coupled with many years' experience in hydraulic engineering have been married in the design of the H.P.M. machines. Combining this with the high standards of British engineering which have gone into its production a noteworthy addition to the range of injection moulding equipment has been made.



(Above) A sectional drawing of the heating chamber showing the torpedo and heater bands. On the right the broken line indicates the position of the wedge lock. The size of the torpedo can be gauged from the position of the wedge which is just forward of the weigh feed unit.



(Right) A reverse view of the machine. The hydraulic oil cooling unit can be seen at the bottom left of the machine.

Injection Moulding without Re-Work

By L. GRIFFITHS *

A review of moulding techniques which dispense with the usual sprue and runners, followed by details of an experimental hot-runner mould.

IN a recent review of automation in injection moulding (1), mention was made of the use of fully automatic machines in conjunction with hot-runner moulds as representing the highest pitch of efficiency in this field. Such a system moulding " Alkathene " in a ten impression disc mould has aroused considerable interest during recent demonstrations in the moulding laboratory of I.C.I. Plastics Division. It permits rapid cycling, and eliminates the need for re-work of sprue and runners. Moreover for certain mouldings where large proportions of re-work adversely effect their behaviour in service, such a technique is particularly attractive. Before describing the experimental mould, it would be appropriate to review some of the moulding techniques variously described as " sprueless moulding," " runnerless moulding," " hot runner moulding," etc.

Let us first consider the conventional sprue and nozzle arrangements of a single impression mould (see Fig. 1). It has long been regarded as good moulding practice to keep the sprue as short as possible. Why not then carry this idea to its logical conclusion by injecting directly into the mould cavity from a heated extension nozzle? (see Fig. 2). This is the simplest method of moulding without re-work and is usually called " sprueless moulding." The technique is widely practised and credit is due to the writers who first published details (2, 3). Successful operation of the technique requires attention to certain vital points which are well worthy of study since the principles involved are common to all methods of moulding without re-work. In the first place, the extension nozzle must be separately heated and have accurate temperature regulation independent of that controlling the main heating cylinder. The basic problem of insulating the hot nozzle from the relatively cold mould is not easily solved but the design shown in Fig. 2, which minimizes the contact area, offers a reasonable solution. In operation, the problem is to prevent freezing of the gates on the one hand, and " dribbling " during the mould-open period, on the other. This is achieved by a judicious combination of gate size and temperature of the nozzle end. Nozzle orifices of size 0.030 in.–0.040 in. have been found satisfactory in conjunction with nozzle-end temperatures of 80°–90° C. for "Alkathenes." Shown in Fig. 2 in addition to the control thermocouple, is a recording thermocouple as near the end of the nozzle as can be contrived, and the aim in moulding is to hold this temperature at the optimum value. This is a matter of balancing the heat input to the nozzle against the heat lost by the nozzle-end to the mould. Mould temperature control is therefore a necessity and channels for fluid circulation should be provided around the feed point.

The system works extremely well in practice and the only inherent defect is the mark left on the moulding by the hot

* Plastics Division, Imperial Chemical Industries Ltd.

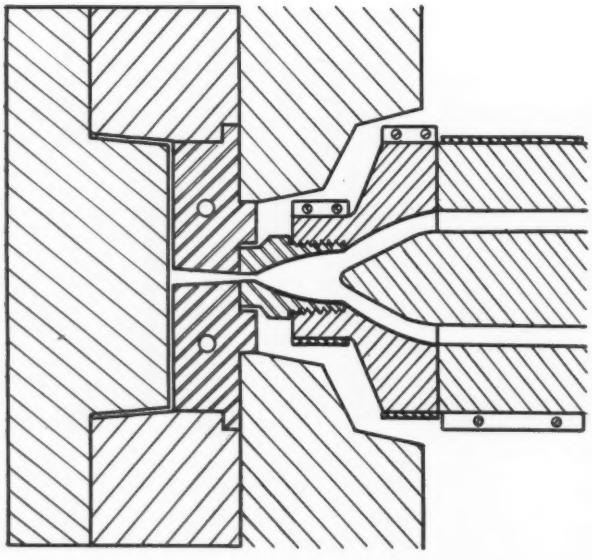


Fig. 1. Conventional sprue and nozzle arrangement for single impression mould.

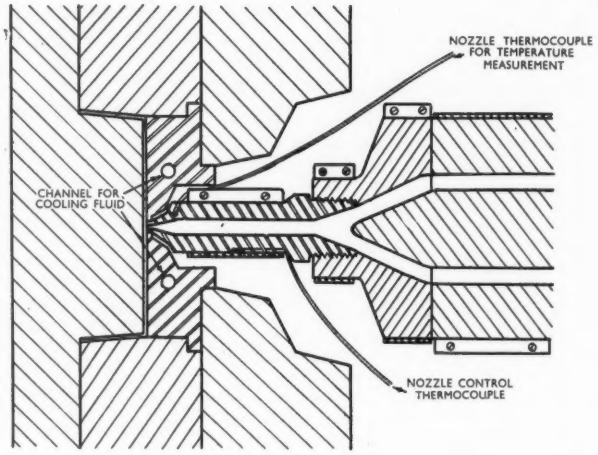


Fig. 2. Extension nozzle for sprueless moulding.

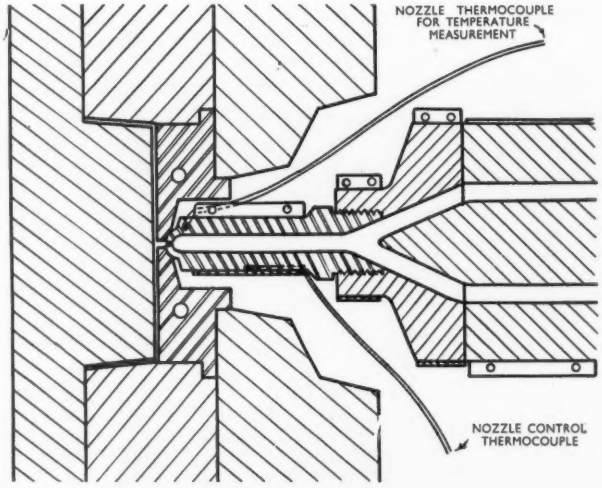


Fig. 3. Extension nozzle with miniature sprue.

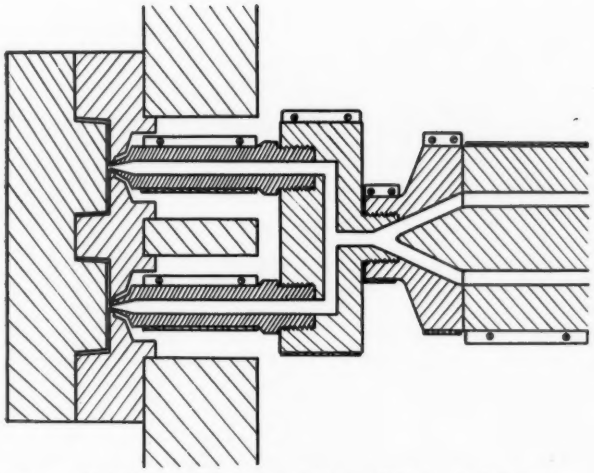


Fig. 4. Multiple nozzle injection, with manifold attached directly to cylinder.

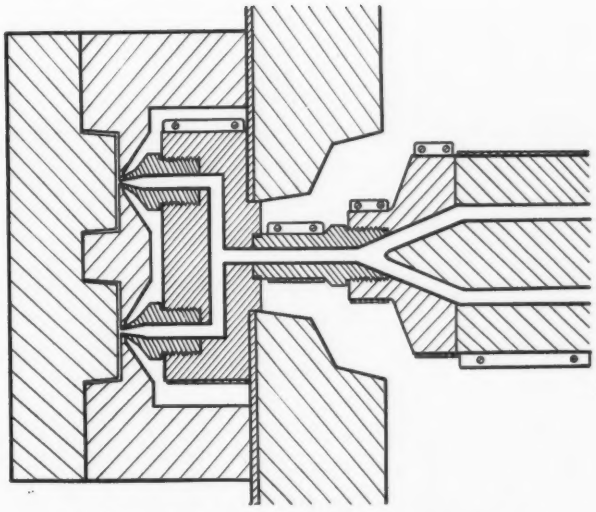


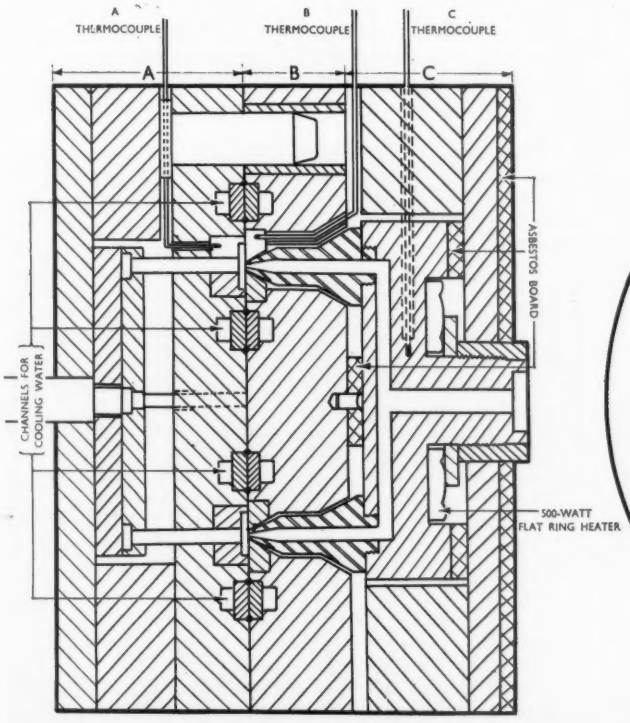
Fig. 5. Multiple nozzle injection, with floating manifold.

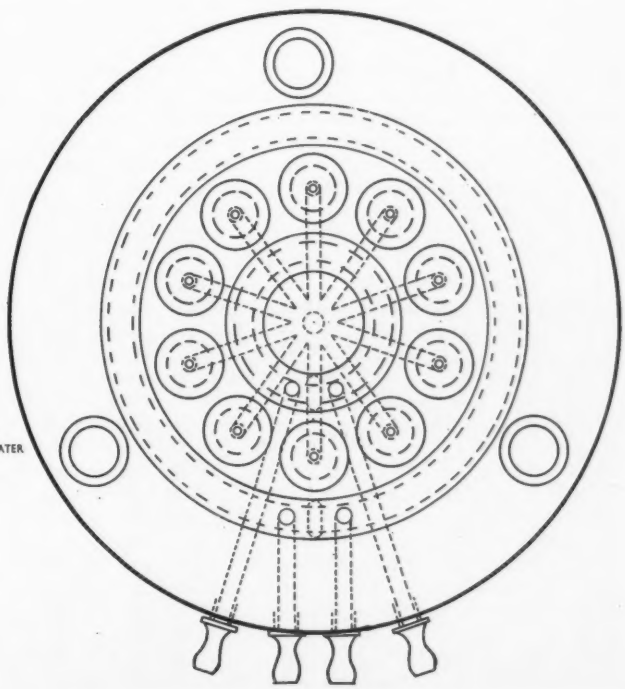
nozzle end. The smaller this is, the less serious the blemish, but if such a mark cannot be tolerated, the design shown in Fig. 3 offers a compromise solution. This virtually reverts to a miniature sprue of the conventional type though operating conditions closely follow those outlined above.

So far, only single impression moulds have been considered. The attractions of moulding without re-work are even greater with multi-impression tools but so also are the difficulties involved. Hot runners must now be introduced linking the heating cylinder to subsidiary nozzles each of which must function on the lines described for sprueless moulding. Several methods of doing this have been reported (3, 4).

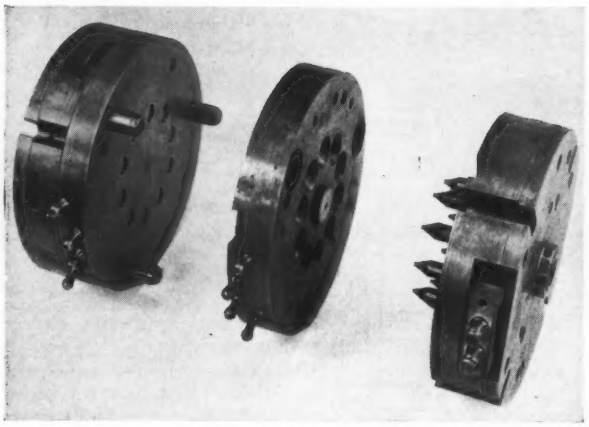
The simplest and most direct approach is to attach to the front of the heating cylinder a heated manifold carrying the appropriate number of channels and extension nozzles (see Fig. 4). Such a system with variations is extensively used for two and four impression tools required for very long runs. But as far as the average moulder is concerned, application of the system is limited by its inflexibility. To accommodate the manifold and multi-nozzles, a special platen is necessary with a predetermined number of nozzle openings which accordingly limits future mould design. The advantages of the construction are rigidity, easy provision of efficient heaters, and simplicity of insulation between hot runners and mould.

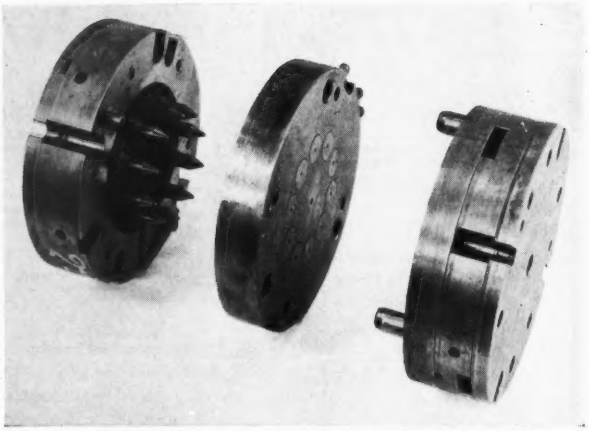
A similar approach which circumvents the need for a special platen is shown in Fig. 5. A standard heating cylinder with extension nozzle is used together with a floating manifold linking the primary nozzle to the secondary ones. This arrangement is a





Figs. 6 and 7. Ten-impression self-contained hot-runner mould.





Figs. 8 and 9. Photographs of mould employed, showing different views of individual plates. In Fig. 8 the plates are, from left to right, A, B and C respectively. They are shown in the reverse order in Fig. 9.

very attractive one for many production mouldings of medium size.

The extreme attraction of hot-runner moulding, however, arises for small parts where 24 or more impressions are required for production economy, and where in conventional tooling, the weight of sprue and runners exceeds the total weight of the mouldings. Quite apart from the cost of disintegrating and blending the scrap, continuous use of large percentages of re-work material can result in serious deterioration of the product. Hence there have been many attempts to design self-contained moulds with confined hot runners feeding into the individual cavities (3, 5). The problems which arise here are identical with those which have already been discussed but their solution becomes increasingly difficult owing to the confined space of the self-contained structure. The outstanding difficulty is to keep both the hot side of the mould hot enough, and the cold side cold enough, for rapid cycling.

When it was planned to carry out development work on this subject at I.C.I. Plastics Division, we chose to design as a modest start, a ten-impression mould for circular discs of $\frac{3}{4}$ in. diameter and $\frac{3}{32}$ in. thickness, primarily for use with " Alkathene." In view of the attractions of the multi-nozzle manifold system, our aim was to incorporate similar features into a self-contained mould. The arrangement finally devised is shown diagrammatically in Figs. 6 and 7 and is illustrated in Figs. 8 and 9. The ten cavities are grouped in circular formation on the moving half (A) of the mould which houses the ejector mechanism and two circular channels of generous bore for water cooling. The fixed half of the mould consists of two parts B and C. Plate B carries the ten mating discs which complete the cavities, the remainder of its face being slightly undercut to reduce heat transfer to the moving half. It also has two circular channels for fluid circulation. Bolted to it, but insulated from it as far as possible, is the manifold plate C carrying ten small nozzles of familiar form. The manifold contains the hot runner entry with ten symmetrical radial runners connecting to the subsidiary nozzles. Heating is provided by a flat ring type electrical element of 500 Watts rating, manually controlled by a Variac auto-transformer. Thermocouples connected to a switched multi-point indicating pyrometer are located at strategic points in plates A, B and C. That in plate A is intended to measure cavity temperature, that in plate B to measure a nozzle temperature, and that in plate C to measure the temperature of the hot runners. When mounted on an injection machine, both mould halves are insulated from the platens by $\frac{1}{4}$ in. thick asbestos board.

Work so far has been carried out using " Alkathene " 20, the mould being fitted to a 2 oz. injection machine with facilities for fully automatic operation. From previous experience with single impression sprueless moulding, it was known that the temperature of the runners should be about 190° C. and that of the nozzle ends approximately 85° C. Early trials showed that these conditions cannot be maintained by the existing ring heater if cold water is passed through the channels of plate B. Our practice is, therefore, to circulate hot water of controlled temperature from a mould heating unit. When starting up, the manifold and subsidiary nozzles are first brought to working temperature after which the main heating cylinder is heated and controlled at 190° C. Moulding can then start without water cooling on plate A. As moulding proceeds, the cavities heat up and water cooling is necessary to hold them at about 60° C. Using fully automatic control, a moulding cycle of 17 seconds was achieved consisting of 12 seconds injection, 3 seconds cooling and 2 seconds mould-open time. The 12-second injection period was taken up mainly by the forward and return strokes of the injection ram and could undoubtedly be reduced by provision of more rapid plunger action.

A machine with rapid plunger action rather than high pressure facility is preferable for this technique with " Alkathene," since the plunger pressures required are only of the order of 3,000 p.s.i. When moulding parts of thin section like these discs, it should be possible to achieve much higher output rates than those obtainable with conventional sprue and runners, because the cycle does not have to include time for these to cool. Moreover, automatic working is facilitated by the fact that there are no runners to eject.

Preliminary experience with the mould has been very promising and many effective demonstrations have been given. However, it is now apparent that the 500 Watt ring heater is inadequate for heating the manifold. To achieve the conditions quoted above for " Alkathene " 20, the heater had to be supplied with full voltage from the Variac transformer leaving no power in reserve. There is, therefore, little hope of using the mould as it stands for stiffer flow grades of " Alkathene." As the wattage rating of the ring heater cannot conveniently be increased, consideration is being given to the provision of induction heating and/or a band heater on the outside of the manifold as was suggested in Fig. 5. Apart from allowing the use of a wider range of materials, it is thought that such a modification will considerably shorten the starting up period and may well dispense with the need to circulate hot water through plate B.

References

1. " Automation in Injection Moulding," L. Griffiths. *Plastics*, XXI, 228, Sept., 1956.
2. " Injection Moulding Problems," H. Spies. *Plasverarbeiter*, 5, 8, Aug., 1954.
3. " Runnerless Injection Moulding," E. P. Moslo. *Modern Plastics*, 32, 8, April, 1955.
4. " New Concept of Hot-runner Moulding," G. W. Whitehead. *Modern Plastics*, 32, 1, Sept., 1954.
5. " The Floating Multi-hole Nozzle Plate," H. Spies. *Plastverarbeiter*, 6, 10, Oct., 1955.

New Productions

Drinking Water Hose

The problem of conveying, by hose, fresh drinking water and other potable liquids from shore installation to ship, is one faced by nearly every shipping and harbour authority.

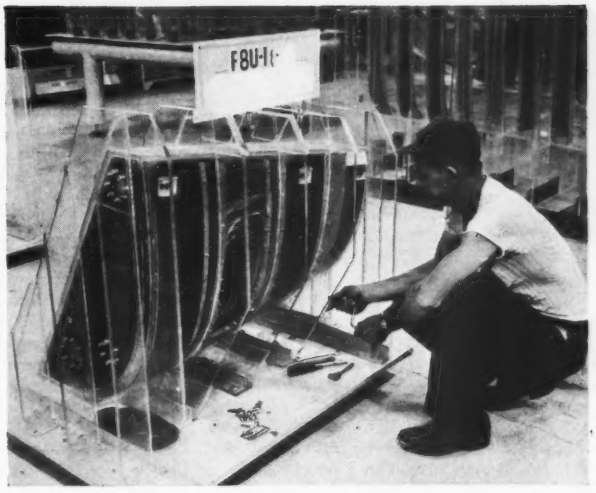
This problem has now been solved, however, with the introduction of an entirely new hose called Plastidry, manufactured by British Tyre & Rubber Co., Ltd., Herga House, Vincent Square, London, S.W.1. Consisting of an odourless and tasteless p.v.c. lining and cover fused on to an all-nylon reinforcing fabric to form a plastic mass of great strength and wear-resistance, the hose is both waterproof and water repellent and cannot absorb water or outside grime. It is also non-rotting, impervious to attacks of rodents, insects and fungi and will not freeze or support combustion.

Manufactured in 1¼ in., 2½ in., 2¾ in. and 6 in. diameters, Plastidry may be used for conveying a wide range of liquids such as beer, wine, glucose and molasses. It is very light in weight, will coil flat and can be rolled "wet" after use and stored in a damp condition without deteriorating.

Laminated Plastics at Scotland Yard

Located on the first floor of the new building of Scotland Yard the Information Room has a 42 ft. long desk with places for 16 operators. All the electronic equipment is housed in furniture veneered with Formica and Black Delaron plastics. The furniture of a teleprinter room and an urgent communications room to deal with "Interpol" and crowd control is similarly veneered.

All the fabrication was undertaken by Scotland Yard's own Works Department at City Road, under the guidance of Mr. J. Innes Elliot, A.R.I.B.A., the chief architect. They designed their own furniture which accommodates a conveyor belt for carrying written messages, electrical indicator and switch panels, telephones and all the necessary cabling.



A Plexiglas test fixture used by Chance Vought Aircraft to check and inspect rubber fuel cells prior to fitting in aircraft wings.

Soap Economiser

One of the latest products of Roy Aitken & Partners Ltd., 48 Dundas Street, Glasgow, C.1, is "The Soap Swish." This useful addition to kitchen equipment consists of an injection moulded cage and handle in which scraps of soap are held. The material used for the moulding is Alkathene H.D., the new polythene moulding powder being produced by I.C.I. This material has a softening temperature of over 100°C so that the soap swish can be used in boiling water without any ill-effects.

Test Fixtures for Fuel Cells

Plastic fixtures permitting visual check on how a fuel cell will fit when installed in the F8U-1 Crusader are being used by Chance Vought Aircraft.

Putting the rubber fuel cells in the aircraft frequently has to be done by feel since smaller ones may be in areas with an opening too small for a workman to do the job visually. By installing the cells in the Plexiglas gauges beforehand, missing or defective fittings or hangars can be spotted visually. Bad fits in corners can be eliminated.

The fixtures are made of half-inch Plexiglas by tool manufacturing shop and afford easy visibility of the black rubber cells from all angles. Each of the different shaped fuel cells has its own acceptance gauge into which it is fitted.

Plastics in the Britannia

The use of plastics in the interior fittings of passenger carrying aircraft has in the last few years increased considerably. Their attractive appearance and low weight have in many cases proved a boon to designers. In addition the low cost of tooling for use in their fabrication is an important factor where comparatively few mouldings are required.

An example of their extensive use is that of the Bristol Britannia where Cobex rigid vinyl sheet has been used for many fittings. In our illustration the following are manufactured from this material: light holders, mirror frames, toilet unit including seat, S.T. dispenser, door fittings, make-up table with the exception of the surface, toilet preparation rack, light fittings and window coamings. In addition the cupboard fittings and drawer faces are of Cobex.

Cobex is manufactured by B.X. Plastics Ltd., Highams Station Avenue, Chingford, London, E.4.

(Left) The Information Room at Scotland Yard after the fitting of Formica and Delaron veneers

(Right) Part of the interior of the Bristol Britannia showing the use of Cobex sheeting.

Plastics News

Plant and Equipment, Materials, Processes, Company News, Technical Literature, Exhibitions, Personal Notes and Meetings.

NEW PRE-HEATER.—A new pre-heater for thermosetting moulding materials has recently been introduced by Radio Heaters Ltd., Eastheath Avenue, Wokingham, Berks. The new model which is known as the Radyne H15, is reported capable of pre-heating loads up to 2 to 4 lb. at the rate of up to 1⅛ lb. or more per minute. The H15 is fitted with Xenon rectifiers which make the equipment free from objectionable temperature effects. The power is tapped for 200 to 250 volts single phase, 50 cycles 3 kW consumption at full power, and 300 W. at standby. The heat output is 1½ to 2 kW and the special oscillator circuit employed permits the heating rate to be varied by adjusting the electrode raising and lowering knob on the top of the lid. The heat output is indicated by a meter on the front of the equipment. The automatic resetting process timer adjustable between 1 second and 10 minutes operates the power supply switch and automatically opens the lid at the end of the heating cycle. The new heater can be mounted on a tubular steel trolley if required.

MEASUREMENT OF SURFACE TEXTURE.—The Perth-o-Meter surface measuring instrument has been designed to meet the requirements of workshop practice in the accurate measuring of the surface texture of mechanical parts. Altogether eight measurements can be obtained but only three are of particular interest. These are the maximum peak to valley height of the roughness; the average roughness and, the bearing area factor of the roughness. The last of these measurements can be taken at different depths so that the improvement in the bearing capacity after removal or reduction of the peaks of roughness can be ascertained.

The instrument consists of a basic unit to which can be added various other units to increase the scope and range of its operation. It is manufactured in Germany by Hommel Werke and distributed in this country by Rubert & Co., Ltd., Chapel Street, Stockport Road, Levenshulme, Manchester, 19, from whom further details can be obtained.

In addition the greater rigidity of the material means a reduction in the number of clips used for its support.

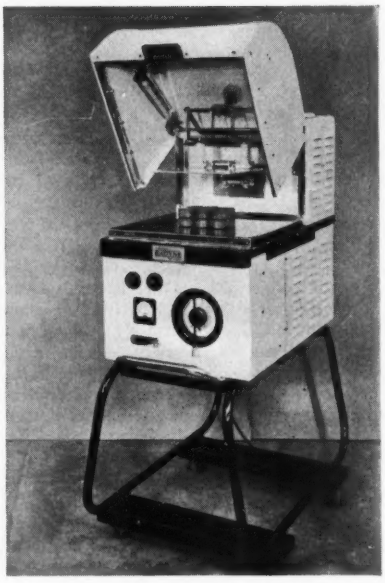
The maximum working pressures at 20° C. recommended for normal gauge B.S.1972 sizes are compared with standard heavy gauge tube in the following table.

Size	"Plastronga" (in thicknesses of Normal Gauge B.S.1972)	Heavy Gauge "Polyorc A" to B.S.1972
½ in.	230 p.s.i.	230 p.s.i.
¾ in.	200 p.s.i.	150 p.s.i.
1 in.	150 p.s.i.	115 p.s.i.
1¼ in.	130 p.s.i.	110 p.s.i.
1½ in.	120 p.s.i.	95 p.s.i.

The new tube is available in 18 ft. lengths in ½ in. to 2 in. normal gauge sizes and in 50 ft., 100 ft., 200 ft. and 500 ft. coils in ½ in. and ¾ in. sizes only.

Nut Making Machine for Laminated Plastics.—Permali Limited have developed a special machine which automatically forms nuts from strip stock, principally Permali densified wood phenolic laminates. This machine has an output of six completed nuts per minute, in Whitworth and other standard threads in sizes from ⅜ in. to ¾ in., and the speed of production is governed at present by the tapping process. The sequence of operations starts with strips of Permali being loaded into the magazine. Each strip is then automatically ejected from the magazine, fed forward, and first drilled and chamfered with a single tool. This is followed by tapping and, finally, the hexagon is formed by sawing. Until sawing takes place, all operations are simultaneous on several nuts (in strip form) and there are five operations in each cycle.

Price Reduction.—Flexo Plywood Industries Ltd., South Chingford, London, E.4 (an Associate Company of Cork Manufacturing Co., Ltd.), announce that, as a result of improved methods of production, the prices of Grade "C" Flexolite translucent corrugated sheets are reduced substantially, with immediate effect. Revised price lists are now available.



The new pre-heater being made by Radio Heaters Ltd.

The Bullows Automatic Fan Control Unit.—The air exhausted from the workshop by a spray booth has been heated at considerable expense, and the displacement of air from the shop for exhaust purposes represents a serious heat loss from the factory.

Alfred Bullows & Sons, Ltd., Long Street, Walsall, Staffs, announce an Automatic Fan Control Unit, Type V1001/2, for spray booth exhaust fans. This unit automatically switches off the fan when the spray gun is no longer in use, and switches the fan on again when spraying re-starts, thus affording a substantial saving in heat losses as well as in electric power to run the fan.

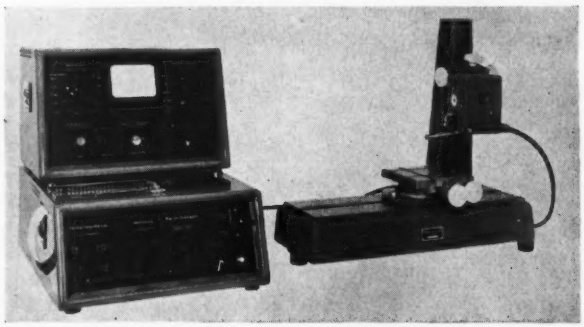
A slight local restriction is fitted in the main air line feed to the spray guns on the booth. The airflow caused by the spraying operation induces a slight pressure drop on the downstream side of the restriction, and the variation in pressure on either side of this is used to actuate a diaphragm cylinder, which in turn controls an air feed valve to a small reservoir, and in turn to a pressure switch which completes the circuit for the fan motor.

A permanent bleed to atmosphere is fitted in the reservoir itself, so that when spraying stops, the pressure in the reservoir gradually decreases until the pressure switch breaks

General

Tubes in Low Pressure Polythene.—The Yorkshire Copper Works Ltd., of Leeds, announce the production of piping extruded from low pressure polythene. For some time this company have been producing fittings in this material for use with their standard Polyorc, polythene tubing.

Claims for the new Plastronga tubing are that its additional strength makes the normal gauges comparable to the heavy gauge tubing in standard polythene. The tensile strength being 3,600 p.s.i. as compared to 1,400 p.s.i.



The German Perth-o-Meter surface measuring instrument which is being distributed in this country by Rubert & Co., Ltd.

contact. The rate of bleed is adjustable, and a variable time lag is produced before the fan motor stops. Normal setting is for a delay of 1½ to 2 minutes after spraying ceases.

Automatic Stamping Machine.—Rockwell Machine Tool Co., Ltd., of Welsh Harp, Edgware Road, London, N.W.2, have commenced the manufacture, under licence, to the U.S. Tool Co. Inc., of the No. 28 and No. 35 U.S. Multi-Slide stamping machine. These machines can produce many different types of complicated stampings which under normal working conditions would require the use of several machines.

The machine is basically a standard unit equipped with an automatic feed, stock straightener, stock check, one horizontally-operated press head, which can be used for piercing, trimming, embossing, swaging, blanking, etc., four horizontal forming slides, 90° apart and converging at one point, and a vertical stripper mechanism; all slides being hardened and ground.

Two or three press heads can be used simultaneously, so that when much cutting or trimming is required the operation in the dies can be spaced, resulting in lowered tool maintenance and greater die life.

The No. 28 machine has a maximum width of stock capacity of 1½ in. and maximum length of feed capacity of 8 in.; the larger No. 35 machine has a width of stock capacity of 3 in. and maximum length of feed of 12½ in.

Correction.—On page 11 of the January issue the Van Heusen showcard was incorrectly captioned and should have read "show card manufactured from Cobex by Cellgrave Co., Ltd." The vacuum formed display units shown at the top of the page were not manufactured by this company. The display figure on the same page was manufactured by Remafa Industrie and Handelmy of Holland in expanded polystyrene.

Literature

British Standard for Methods of Testing Plastics.—The publication of this British Standard B.S.2782 : 1956, Part I, launches the first part of what will become a series of test methods used by the plastics industry for assessing the quality of its products. The standard was prepared with the full collaboration of the British Plastics Federation.

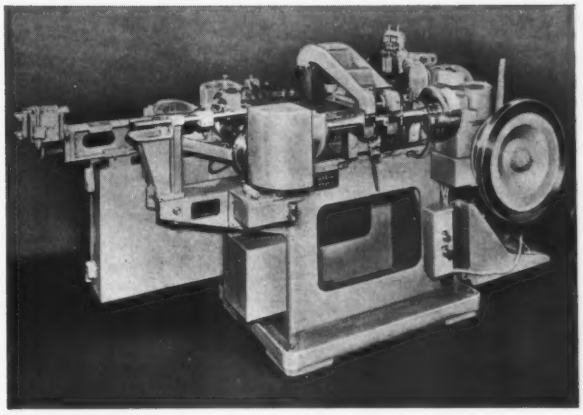
Part I contains a group of test methods which can reasonably be considered to be of use in assessing the effect of temperature on plastics and associated products.

Copies of this standard may be obtained from the Sales Branch, British Standards Institution, 2 Park Street, London, W.1. Price 10s.

Company News

Warbrick (Engineering Specialties) Ltd., have been appointed British representatives for the Blast Press bottle blowing machine. The Model II can produce up to 120 articles per hour using two moulds. The maximum volume for the bottles produced is 5 litres on this machine.

Further details can be supplied on application to the above company at Barclays Bank Chambers, Sankey Street, Warrington, Lancs



The U.S. Multi-Slide automatic stamping machine now being made in this country.

Imperial Chemical Industries Ltd. are to increase production of "Terylene" polyester fibre to 30 million lb. a year by extending sections of the "Terylene" plant at Wilton in North Yorkshire.

Work will begin in the Spring of 1957, and additional quantities of "Terylene" will become available early in 1959. The present annual capacity of the plant is 22 million lb.

Omni (London) Ltd., 35 Dover St., London, W.1, announce that they have been appointed U.K. representatives of the Rubber & Asbestos Corporation of Bloomfield, New Jersey, for the sale and distribution of the adhesives for manual application manufactured by the latter company.

Artrite Resins Ltd. is a new company with offices at Kingsway Chambers, 44/46 Kingsway, London, W.C.2, formed to market a range of polyester compounds formulated for different applications and fabricating techniques. In addition a complete range of polyester resins is available for users wishing to carry out their own compounding, and also stocks of glass fibre reinforcing materials are being held. An advisory service on mould and product design is also available.

The activities of the company are under the direction of Dr. G. Ader.

Hess Products Ltd.—The head sales office of Hess Products Ltd., the manufacturers of Distec fatty acids, has moved to 147 Kirkstall Road, Leeds, 3. The telephone number, Leeds 30194, and the telegraphic address "Distec Leeds" are unchanged.

Davis & Timmins Ltd. announce that they have opened a new Stock Depot at 5 Wandsworth Parade, Belfast, under the managership of Mr. W. T. Graham.

Air Control Installations Ltd. have moved their Birmingham office to larger premises at Wolverley House, Digbeth, Birmingham, 5. Telephone number Midland 5148.

Union Carbide Research Institute.—The formation of the Union Carbide Research Institute to engage in basic scientific research has been announced by Morse G. Dial, President of Union Carbide and Carbon Corporation. It will be located on the Corporation's Westchester property near Tarrytown, New York.

The Institute will be under the administration of Dr. Augustus Kinzel, Vice-President-Research of Union Carbide. Dr. E. R. Jette, formerly head of the Chemistry and Metallurgy Division at Los Alamos Scientific Laboratory, New Mexico, has been appointed the director of the Institute.

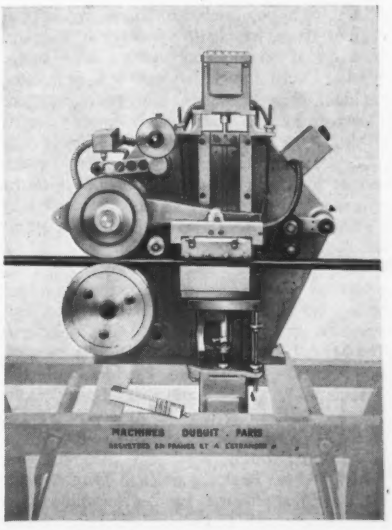
Wolf Electric Tools Ltd. has moved its Head Service Department for the home counties from 239 Acton Lane, London, W.4, to larger premises at Newlon Works, off Stanlake Villas, Stanlake Road, Shepherds Bush, London, W.12. Telephone number Shepherds Bush 4414/5/6.

Williams (Hounslow) Ltd. have recently acquired the total share capital of J. C. Oxley's Dyes & Chemicals Limited, manufacturers of aniline dyestuffs, auxiliary products and chemicals, of Dewsbury, Yorkshire.

They have also acquired the share capital of the Heckmondwike Chemical Co., Ltd., manufacturers of fertilizers, insecticides and allied products, of Heckmondwike, Yorkshire.

Conferences

Short Practical Course in Plastics Technology.—Following the successful course held last year a similar short, full-time course is being offered during April 8–18, 1957, at the College of Technology, Birmingham, for the benefit of those who, in the main, are already employed in the plastics industry and who wish to gain practical experience of a wide range of techniques and materials.



The Dubuit automatic pipe marking machine sold in the U.K. by Dubuit Ltd.

Exhibitions

Cologne Household Goods and Hardware Fair.—This International fair is being held from March 8 to March 11. Fifteen countries will be exhibiting and plastic articles will be a feature of many stands.

The Ninth Technical Exhibition of the Oil and Colour Chemists' Association will take place on March 12, 13 and 14 at the Royal Horticultural Society's New Hall, London, S.W.1. This exhibition which is the largest yet organised has 87 companies and research associations taking part.

Personal

Mr. Eric N. Adlington has been appointed Deputy Managing Director of Temple Press Limited. He has been with the Company for 31 years and a member of the Board of Directors since 1948.

Mr. John N. Dean, Chairman of The Telegraph Construction & Maintenance Co., Ltd., was awarded a knighthood in the New Year's honours list. Mr. Dean has been with Telcon since 1922 and was appointed a technical director in 1945. In 1950 he succeeded Sir Geoffrey Clarke as managing director and in November, 1954, became chairman of the company.

Mr. A. Collins of The Micanite & Insulators Co., Ltd., was awarded an M.B.E. in the New Year's honours list. Mr. Collins is well known in connection with industrial insulating materials and has been associated with the work of the B.S.I. and the E.R.A. for many years.

Mr. W. G. Burnett has retired from the board of Prices's (Bromborough) Ltd. **Mr. B. R. Hook** has been appointed sales director of the company.

Mr. Maldwyn Jones has been appointed development director of the Plastics Division of I.C.I. Mr. Jones has been technical service development manager of this division since 1945. **Mr. H. C. Raine** has been appointed research director of the Plastics Division. He was made an Assistant Research Manager of the Plastics Division in 1950 and a deputy director in 1954. Mr. Raine is also a director of British Visqueen Ltd.

A third appointment announced by I.C.I. is that of **Dr. I. M. Smith** formerly an assistant manager of the sales control department of the Plastics Division, who has now been appointed regional sales manager, plastics department Northern Region Sales.

Mr. R. F. Mayne has retired from The Micanite & Insulators Co., Ltd., after 40 years' service in their mica department of which he was manager for 34 years. He is succeeded by **Mr. A. W. Townsend** who has been his assistant for 26 years.

To mark the occasion Mr. Mayne has been presented with a cheque from the Directors (presented by Mr. H. A. Cooper, Director and Joint General Manager), a fishing rod from The M. & I. Foremen's Association (presented by Mr. D. J. Greene, President of the Association), and a convector heater from The M. & I. Long Service Association (presented by Mr. S. W. Messent, Vice-Chairman of the Association).

Mr. W. G. Baldock, Sales Manager, with Williams (Hounslow) Limited, Aniline Dye Manufacturers of Hounslow, Middlesex, retires in March after 33 years' service with the company.

Mr. J. E. Currie and **Mr. A. J. Perryman** were appointed Joint Managing Directors of Catalin Limited. Mr. Currie is also Chairman and Mr. Perryman, who joined the Company in 1937, was previously General Manager.

Mr. R. T. de Poix has been elected Chairman of the Zinc Development Association for 1957.

Dr. G. I. Higson relinquished his appointments as a Director and as Chairman of British Titan Products Co., Ltd., as from December 31, 1956.

Mr. G. H. Beeby has been appointed Chairman.

Horner's Company Plastics Dinner.—On January 18, at the Fishmongers' Hall, Mr. Ronald Ward read a paper "Plastics in Building," following the annual Plastics Dinner of the company. The Master, Mr. Tom Clark, presided.

Mr. Charles Waghorne, President of the British Plastics Federation presented the prizes awarded for the best design in plastics. Prizewinners were Mr. E. J. Arundell, Mr. V. Smith of E. K. Cole Ltd., and Mr. K. Braine of Bakelite Ltd.

Meetings

February

15th.—"New Polythenes" by Dr. Von Klenck. Midlands Section of the Plastics Institute, The James Watt Memorial Institute, Birmingham. 6.30 p.m.

18th.—"Testing Methods and Equipment" by F. N. B. Bennett. The Leicester Section of the Institution of the Rubber Industry, The Bell Hotel, Leicester. 7.30 p.m.

20th.—Junior Lecture "Machinery" by James Butler. London Section of the Plastics Institute, to be held at the Borough Polytechnic, Borough Road, S.E.1.

20th.—"P.V.C. and its Applications," North-Eastern Section of the Plastics Institute, The Second Dining Room of the Eldron Grill, Grey Street, Newcastle. 7 p.m.

20th.—"Rubber and Plastics Testing Equipment." A joint meeting of the Southern Sections of the I.R.I. and the Plastics Institute at Portsmouth.

20th.—"P.V.C. Compounding for Various Applications" by S. Mottram and D. A. Lever. The Scottish Section of the Plastics Institute at Edinburgh.

22nd.—"Blow Moulding." The North-Western Section of the Plastics Institute at the Engineers' Club, Albert Square, Manchester, 2. 6.45 p.m.

22nd.—"Electronics in Industry." Birmingham Branch of the Incorporated Plant Engineers at the Leofric Hotel, Coventry.

26th.—"Heating and Ventilating in Modern Works." The South Wales Branch of the Incorporated Plant Engineers at South Wales Engineers' Institute, Park Place, Cardiff. 7.15 p.m.

26th.—"Structure and Reactivity of Phenol/Formaldehyde Condensates" by R. W. Hall, A. L. H. Raum, D. Fraser and P. A. Jenkins. The Society of Chemical Industry, Plastics and Polymer Group, London. 6.30 p.m.

27th.—"Fibrous and Non-Fibrous Insulation for use in High Voltage Power Equipment" by W. J. Renwick and Mr. Blewitt. The Western Section of the Plastics Institute, The Wheatstone Hall, Gloucester. 7 p.m.

March

4th.—"Ziegler Polyethylene" by Dr. E. T. Borrows, and Ir. E. Lelyveld. The London Section of the Plastics Institute, Manson House, 26 Portland Place, London, W.1. 6.30 p.m.

4th.—"Structural Applications of Plastics" by A. J. Warner. The Society of Chemical Industry, Plastics and Polymer Group, a joint meeting with Yorkshire Section S.C.I. at Leeds.

5th.—"Polyurethanes." The Midlands Section of the Plastics Institute, The Grand Hotel, Leicester. 6.45 p.m.

11th.—"Practical Application of Slush Moulding and Plastisol" by S. Mottram. The Preston Section of the Institution of the Rubber Industry, The Bull and Royal Hotel, Church Street, Preston. 7.15 p.m.

11th.—"Extruders and Extrusion" by A. Crowther, and R. Robinson. The South Wales and Monmouthshire Section of the Institution of the Rubber Industry, The Angel Hotel, Cardiff. 7.30 p.m.

12th.—"Petroleum as a United Kingdom Source of Raw Material for Synthetic Rubber" by A. A. Appleton. The London Section of the Institution of the Rubber Industry, The Royal Society of Tropical Medicine and Hygiene, 26 Portland Place, W.1. 5.30 p.m.

13th.—"Polyesters and Isocyanates in the Rubber and Plastics Industries" by Dr. J. T. Watts. Joint meeting of the Institution of the Rubber Industry's West of England Section, with the Plastics Institute at the Royal York Hotel, George Street, Bath. 7.30 p.m.

13th.—"Use of Plastics in Packaging" by D. C. Stannard. Yorkshire Section of the Plastics Institute at St. Marks House, 186 Woodhouse Lane, Leeds.

13th.—"Low Pressure Polythene" by Dr. Grams. The South Wales and Monmouthshire Section of the Plastics Institute at the Angel Hotel, Cardiff. 7 p.m.

"Plastics in the Service of Man"

The following is a list of full names and addresses of companies mentioned in the illustrated feature, "Plastics in the Service of Man," which appears on pages 44 and 45 in this issue:—

71. "Plastics in Packaging"

Alkathene—I.C.I. Ltd., Plastics Division, Black Fan Road, Welwyn Garden City, Herts.

Bexoid—B.X. Plastics Ltd., Higham Station Avenue, Chingford, London, E.4.

British Cellophane Ltd., 12–13 Conduit Street, London, W.1.

Courtaulds Ltd., Little Heath, Coventry.

Thos. De La Rue & Co., Ltd., Imperial House, 84/86 Regent Street, London, W.1.

Denman Products Ltd., Welwyn Garden City, Herts.

Injection Moulders Ltd., Westmoreland Road, The Hyde, London, N.W.9.

Lacrinoid Products Ltd., Gidea Park Works, Stafford Avenue, Gidea Park, Essex.

Low & Bonar Ltd., 63/73 King Street, Dundee.

Mentmore Manufacturing Co., Ltd., 1 Bradley Road, Wood Green, London, N.22.

John Millar & Sons, Ltd., Edinburgh.

Plastic Weldings Ltd., 11B Strafford Road, Acton, London, W.3.

E. Shipton & Co., Ltd., Ferndown, Northwood Hills, Middlesex.

Spesco Developments Ltd., 195 Uxbridge Road, Hampton Hill.

Universal Metal Products Ltd., Langley Road, Pendleton, Salford 6, Lancs.

Amino moulding powders are nowhere obtainable in greater variety of grades or colours than from B.I.P. No less than ten standard grades are available and, additionally, special types evolved to meet particular requirements. The range is ever-increasing, and B.I.P. is always ready to develop and supply "tailor-made" moulding materials wherever a reasonable market offers. Most B.I.P. moulding powders pellet satisfactorily and are made in easy, easy/medium, medium and stiff flow.

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Beetle XP
Plasticised Paper-Filled Urea Moulding Powder for Low 'After Shrinkage'. BSS.1322 Type UX.

Beetle XT
2nd Grade Paper-Filled Urea. Whites, Cream, Natural, Opal and Red. BSS.1322 Type U.

Beetle TXC
Special Cellulose-Filled Urea Moulding Powder of High Translucency. For high quality button production.

Beetle BW
Improved Wood-Filled Urea Moulding Powder for good surface finish. Attractive colour range. BSS.1322 Type U.

Scarab
General Purpose Wood-Filled Urea Moulding Powder. Unlimited opaque colours. BSS.1322 Type U.

Plasticised Scarab
Plasticised Wood-Filled Urea Moulding Powder for good dimensional stability. BSS.1322 Type UX

Melmex
Melamine Cellulose-Filled Moulding Powder. Particularly suitable for heavy duty tableware. BSS.1322 Type M.

K.592 and K.593
Mineral-Filled Melamine Moulding Powders for high duty electrical applications.

E.410
Glass-Fibre Filled Melamine Moulding Powder of good mechanical strength and exceptional electrical properties.

Alkyds
Granular and Self Extinguishing types of Alkyd Moulding Powders. Quick curing materials for electrical applications.

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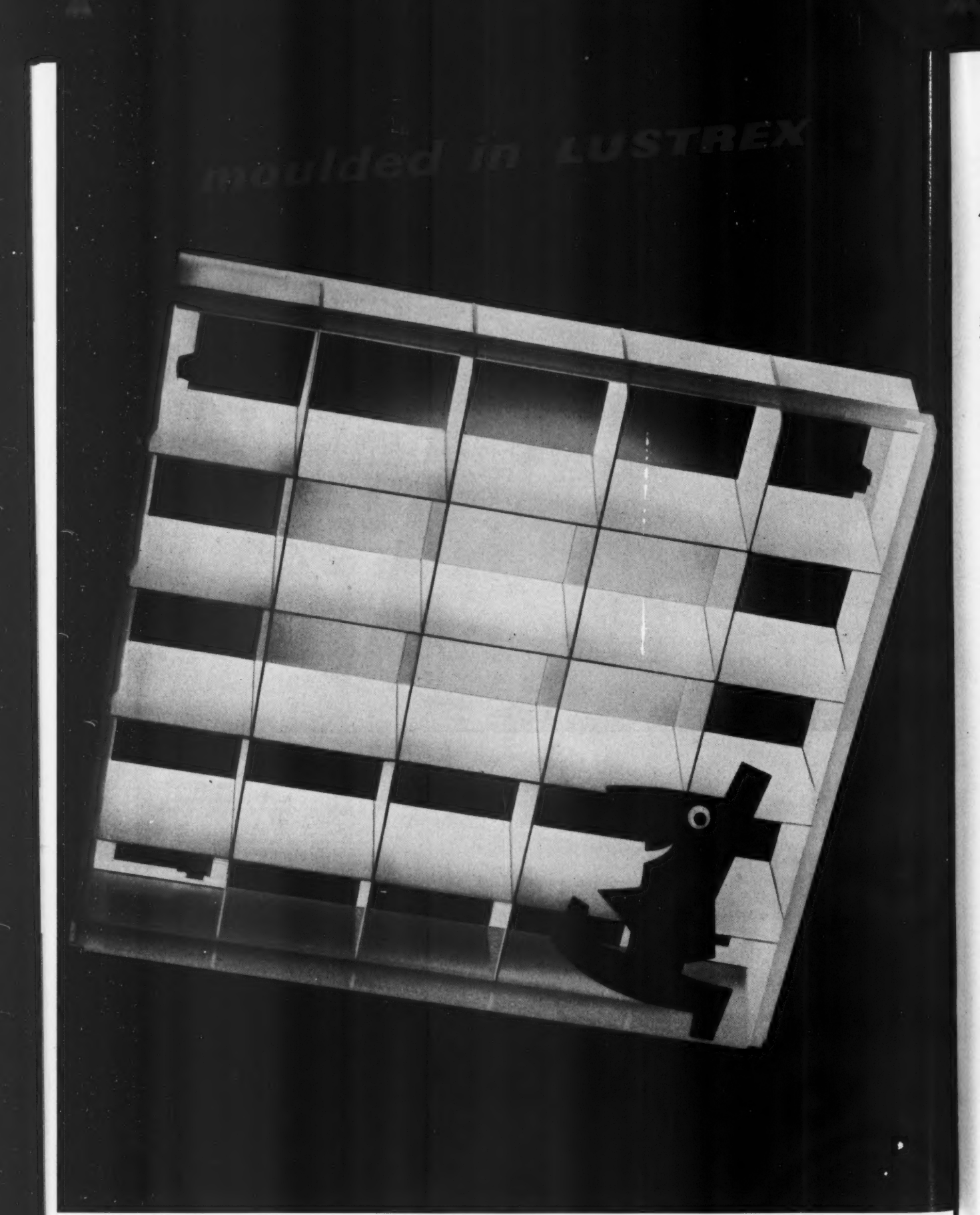


Luve-tile moulded in Lustrex by E. Elliott Ltd., for Harris & Sheldon (Electrical) Ltd.

Lustrex is a Registered Trade Mark.

MONSANTO

MONSANTO PLASTICS LIMITED,

196 Monsanto House, Victoria Street, London, S.W.1. and at Royal Exchange, Manchester, 2.

In association with: Monsanto Chemical Company, St. Louis, U.S.A. Monsanto Canada Limited, Montreal. Monsanto Chemicals (Australia) Ltd., Melbourne. Monsanto Chemicals of India Private Ltd., Bombay. Representatives in the world's principal cities.

Automation Equipment

Portable Metal Sorter and Resistivity Measurer.—This direct reading instrument consists basically of an investigating head on a lead plugged into a small instrument case. When the test head is brought near to the metal, its inductance changes. The oscillator in the instrument case ceases to oscillate. The calibrated dial is rotated until the oscillator comes into action again. This point is indicated by the left-hand meter, and the reading of the calibrated dial at this point is the specific resistivity of the metal in micro-ohms per centimetre cube.

The Solartron Electronic Group, Ltd., Thames Ditton, Surrey.

Universal Bridge.—The B.221 is a highly accurate transformer ratio arm bridge of advanced design. It provides facilities for the two-, three- or four-terminal measurement of impedance or transfer admittance over an extremely wide range at an operating frequency of 10,000 radians/sec. (1592 c/s).

Measurement is unaffected by the impedance of the test leads which can therefore be of any length. Consequently the instrument is ideally suitable for the determination of temperature coefficient of components under test conditions or, in fact, any remote *in situ* measurement.

A novel mechanism automatically displays the cyphers, decimals and units of measurement. This gives direct reading and avoids any confusion which might be caused by the large multiplying factors involved.

The basic range of the instrument covers impedances from 10,000 megohms to 10 ohms and this is extended to 50 micro-ohms by the use of the Low Impedance Adaptor. Other adaptors have been designed for measurement of conductivity, dielectric constant and loss factor of solids and liquids.

The Wayne Kerr Laboratories Ltd., Roebuck Road, Chessington, Surrey.

Compression Cycle Controller.—The E364 Robotron process control unit has been designed to give a wide variety of press cycles to suit any material or mould. Particular attention has been given to the breathing cycle and the unit is fitted with 24 push buttons each representing a time period of $\frac{1}{4}$ minute. According to their setting the press will or will not breathe during the three minutes period they cover. Further control of the breathe cycle is by a dial timer with a range of $\frac{1}{4}$ to 15 secs. which measures the time for press opening at each breathe.

A 27 point selector switch will determine the time, which added to the three minute breathe period, will make up the overall cycle. So that a longer range of cycles are available, these 27 extra time steps are longer, and by means of a selector switch have optional values such as $\frac{1}{4}$ or $\frac{1}{2}$ minute.

On the control panel also are a reset pushbutton, a fuse and a hand/automatic switch. With the cover closed and locked, the press operator has access only to the external pushbutton and manual open/close switch. The pushbutton has a dual function. At first operation, it acts as a starting pushbutton. At any time later it acts as an emergency open button. It does not reset the controller and the operator must hold the button to keep the press open.

The principle of operation is that the starting pushbutton locks up a relay that supplies current to the solenoid valve and also starts a timing motor. This timing motor turns a contact arm across a number of contacts to establish a time pulse every $\frac{1}{4}$, $\frac{1}{2}$ or $\frac{1}{4}$ minute. Each time pulse advances a stepping switch one position. The first 24 stepping switch contacts are consecutively wired to the breathe pushbuttons and the next 27 stepping switch contacts are consecutively wired to the points of the selector switch.

A closed circuit at any of the pushbuttons will open the feed to the solenoid valve and start the breathe timer. The selector switch provides a closed circuit at selected time, to release the main relay and reset the control instantly.

Emmett Machine and Manufacturing, Inc., 445 E. Turkeyfoot Lake Road, Akron 19, Ohio, U.S.A.

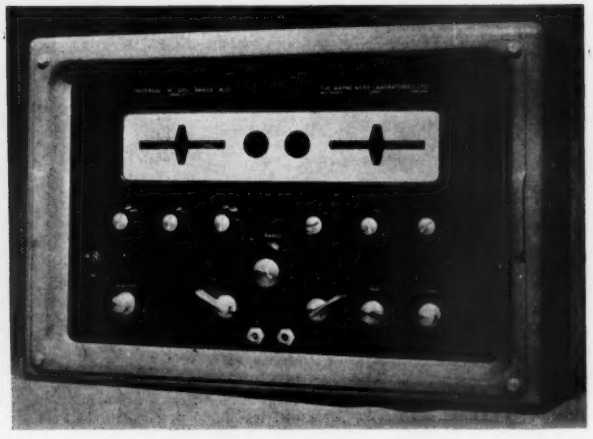
The Robotron compression moulding cycle control unit.

High-Speed Indexing Mechanism.—As the illustration shows, the mechanism consists of only two co-operating elements; the turret and the cam. The turret has radially arranged equally spaced follower-rollers, which engage the driving-cam. The cam can be considered as a special type of worm having a helix of varying pitch angle. Part of the worm " thread " is straight, while other parts are curved. When the rollers are on the straight section of the thread, the turret is rigidly held in position, so that a " dwell " occurs during which any production operation can be performed. The intimate contact of the rollers with the cam profile automatically locks the turret with extreme accuracy.

Since the cam is rotating continuously the rollers, having locked the turret during the dwell period, commence to index it as they start to move along the curved section of the thread. As one roller moves across the cam and leaves it on one side, the next roller enters it on the other side. Regular intermittent indexing of the turret is thus produced.

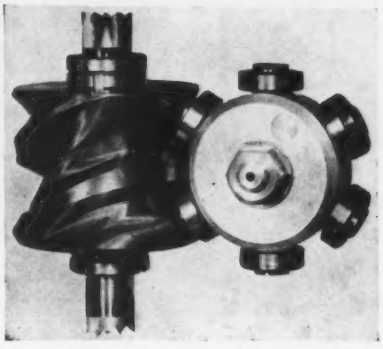
By the suitable design of the cam surfaces, indexing times from 25 to 100 per cent. of the cycle can be achieved and indexing speeds of 750 or more per minute are claimed.

Manifold Machinery Co., Ltd., 660 Great Cambridge Road, Enfield, Middlesex.



(Left) The new Universal Bridge designed and produced by Wayne Kerr Laboratories Ltd.

(Right) The worm and cam mechanism for high-speed indexing manufactured by Manifold Machinery Co., Ltd.



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TALKING SHOP . . .

London Section Dinner-Dance. On January 18 the London Section of the Institute held its annual ladies' night at the Criterion in Piccadilly. A record number of 330 attended, and were received by the Section's Chairman and his wife, Mr. and Mrs. Phillip Morgan. These events seem to get jollier every year—at one in the morning sedate elder statesmen of the industry could be seen rocking and rolling with a skill hardly to be believed.

A notable innovation was a tombola organized to raise funds for one of the charitable causes within the industry. Presided over by Miss Caroline Dalgethy, this was what is known in the trade as a sell-out. For nearly two hours a gambling-crazy crowd surged around Caroline and her helpers, to win prizes ranging from a pig-skin cigarette box to an orange. Mr. John Winstone, a member of the London Section Committee, deserves great praise for the very considerable work he put into organizing this excellent tombola.

* * *

Borough Polytechnic Short-Course. Amongst the companies who sent personel to take part in this course in January were Thomas De La Rue & Co., Ltd., Vinatex Ltd., Bexford Ltd., Greenwich Plastics Ltd., The Telegraph Construction and Maintenance Co., Ltd., Monsanto Chemicals Ltd., Microcell Ltd., and the Armstrong Cork Co., Ltd. Lecturers included Mr. S. Smith, chief engineer, R. H. Windsor & Co., Ltd., Mr. R. Green, Pulsometer Engineering Co., Ltd., Dr. H. P. Zade, Rediweld Ltd., Mr. L. Griffiths, I.C.I. Plastics Division, Mr. E. Cook, Telegraph Construction and Maintenance Co., Ltd., Mr. M. Muns, Projectile and Engineering Co., Ltd., Mr. H. Martin, Fraser and Glass Ltd., and Mr. D. Crabtree, Styrene Products Ltd.

I visited the polytechnic during the course, and was most impressed by the attendance. Equally gratifying was the ready help by industry in the supply of plant and lecturers. Two new additions to the practical facilities must be mentioned—The Windsor twin-screw extruder and the Pulsometer vacuum forming machine. If the industry continues to support education in this way we may yet see a National College for Plastics Technology.

* * *

Polythene Consumption in Canada Rises. Reported in the *Financial Times* for January 9 was a 30% increase in polythene usage in Canada over the figures for 1955. Now running at 22m. lb. a year, nearly half goes into pipe and film. For 1957, a further 30% increase is expected.

* * *

Lecture for Young People. Mr. James Butler, the development manager of British Industrial Plastics Ltd., gave the Plastics Institute's third lecture for young people on January 2. This very popular annual event is always well attended (competition from the grown-ups is getting bigger), and Mr. Butler excelled himself in a fascinating talk on plastics and the engineer, Mr. J. Lionel Daniels, President of the Institute, took the chair.

* * *

New Year Honours. Mr. Albert Collins, of the Micanite and Insulators Co., Ltd., has been awarded the M.B.E., for political and public service.

* * *

Promotion at Grangemouth. I was very pleased to hear the other day that Mr. C. E. Evans, O.B.E., formerly general manager of the Grangemouth plant of British Hydrocarbon Chemicals Ltd., has been made general manager of the company. Under his care, tremendous expansions have taken place at the Grangemouth site. Mr. D. Blair Watt has been appointed his successor.

* * *

Toy Fair. Every year, the Toy Fair at Harrogate draws buyers from all over the world. To our industry, the toy trade represents an important outlet for moulding materials, and my photographer obtained the pictures below which indicate the high standard of fabrication now employed. This is equally true of the toys made from sheet materials such as p.v.c.

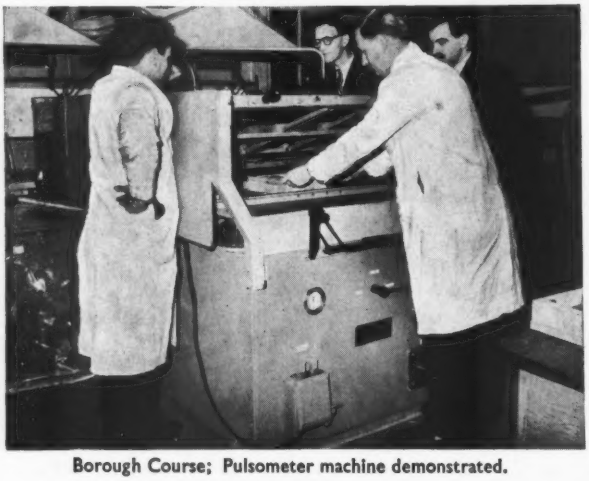
* * *

Thermo-Plastics Ltd., Silver Jubilee. On January 16, Mr. and Mrs. Reingand, directors of Thermo-Plastics Ltd., were both at a Silver Jubilee party at Luton. Although held primarily for the staff, a small number of old friends were able to be present to see Mr. Reingand, the managing director, presented with a portrait of himself, commissioned and paid for by his employees. In his review of the past 25 years, he paid special tribute to the strenuous efforts of the staff which had contributed so much to the company's success.

The expansion of Thermo-Plastics has been remarkable; in 1932 when the company was formed, cellulose acetate was the only material employed, and the field of operation covered signs and display items. Today the organization has large factories at Dunstable and Welwyn Garden City, and all types of materials are handled. The company has, since the outbreak of the second world war, held a particularly important stake in the application of plastics to the aircraft industry.

PLASTIKON.

Above (left). Miles of dolls; the stand at the International Toy Fair, Harrogate, of Cowan (Dolls) Ltd. Above (right). Inflatable beach toys on the stand of Cascelloid.



Borough Course; Pulsometer machine demonstrated.

Musical instruments shown by Selcol Products, Ltd.

Recent Developments in West German Plastics Machinery

By V. BIRD

IT is over 30 years since the West German firm of Eckert & Ziegler G.m.b.H., Wiessenburg/Bay., constructed their first plastic injection moulding machines and brought them onto the market. Today the company is building seven sizes ranging in injection capacity from 0.25 to 16 oz. per shot of polystyrene. In the years following the introduction of this type of machine by the above-mentioned manufacturer, other firms have engaged in the building of injection moulding machines which are, today, being built to a very high degree of perfection. The fact that these machines may be arranged for manual, semi-automatic, and automatic repeat operation, provided with individual self-contained or group drive, and equipped with toggle or hydraulic mould clamps indicates the wide variety of available designs.

The injection moulding machine SE 35 by Ankerwerk Gebr. Goller, Nuremberg, is of an automatic type, injects about 2 oz. of polystyrene per shot, and has a plasticizing capacity of 22 lb. per hour. By a clever arrangement of control gear, push button panel, accessories, and guards for accident prevention, the designers have been able to create a machine of pleasing appearance.

The production cost may be reduced either by the introduction of fully automatic cycle operation or by an increase of the number of operating cycles per given time whereby this number may be limited by the properties of the thermoplastic material being handled. Gebr. Battenfeld, Meinerzhagen, have introduced automatic cycle operation by replacing the common multiple-cavity moulds through single-cavity moulds. This company's line of injection moulding machines with smallest sizes having injection capacities of 0.35 and 0.17 oz. per shot is characterized by toggle-operated mould clamps.

Reduced operating time as well as improved power flow are among the outstanding features of the injection moulding machine DS 30 VA by Dr.-Ing. Fritz Sommer Nachf., Lüdenscheid. Instead of the plunger, the cylinder of this injection moulding machine is moved to force the material into the mould, the injection stroke of the cylinder and the closing stroke of the movable half of the mould being unidirectional in contrast to more conventional designs in which these movements are performed in opposing directions.

Injection moulding machines are generally built for handling polystyrene. Cellulose acetate and aceto-butyrate materials can be processed by these machines when the injection cylinder is heated to the required temperature. The later types of thermoplastics such as polyethylene, the polyamide resins, polyvinyl chloride and others, on the other hand, require specially adapted plasticizing cylinders which the manufacturers supply with their standard machines as special accessories.

According to general practice, the injection cylinder is placed horizontally. This arrangement is advantageous because all components are easily accessible, and the operation is easy to supervise, although a vertical positioning of the cylinder might be preferred for special applications. The vertical injection moulding machine, model Ve VHS III, by Paul Flesch, Lüdenscheid, requires very little floor space. Inserts can be placed into moulds with greater ease, and such moulds for embedded parts can be produced at lower cost when the cylinder assembly is arranged vertically.

Granulating

The manufacturing programme of "Condux-werke" Herbert A. Merges KG., Wolfgang, near Hanau, comprises machine types for any range of capacity, for the granulating of thermoplastics. The cutting mills are at present available in six different sizes.

The smaller models can be attached to any automatic injection-moulding machine, but they are equally well suited for conducting tests in laboratories for the reclamation of plastic scrap. Cutting mills with built-in motor allow easy opening and access to the cutting chamber after loosening two handwheels.

There are several methods of production and processing of synthetic materials, thermoplastics, and materials with rubber-like properties from which large, bulky pieces result. Production requirements of plastic processors call for their reduction to suitable size in one working operation. For this purpose, the above manufacturer offers a cutting mill for large slabs and blocks of thermoplastic and rubber-like synthetic materials (dimensions up to 20 × 12 × 16 in.) that reduces them to correct size for further processing and forming to finished shapes.

Successfully dealing with larger parts and the high shearing-strength values of thermoplastics lately introduced is also a cutting mill of sturdy construction and large feed hopper (20 × 12 × 16 in.) which is manufactured by Fellner & Ziegler G.m.b.H., Frankfurt a.M.

Plastics granulating machines are available in two types, viz, strip and strand granulators. The moulding compound as it is fed into injection moulding machines or extruders is generally a pre-treated material which might be coloured or mixed with lubricants and which is supplied to plastics processors in the form of small cylindrical, square, or irregularly shaped pellets or granules. The pre-mixed material is formed, for instance, into a continuous strip by an extruder. The strip is then slit into strands which are finally cut into cube material by a set of rotating knives. Condux-Werk builds such granulators capable of handling strips from $2\frac{1}{8}$ to $17\frac{3}{4}$ in. wide, chopping them at speeds ranging from 5 to 200 ft. per minute. The machines can be set to produce cubic granules having edges $\frac{1}{4}$ and $\frac{1}{16}$ in. long. The term strand granulator designates a machine into which a plastic strip of multiple strands is fed from the extruder. These granulators operate at speeds from 3 to 440 ft. per min.

Mixing

Although processors of polystyrene and the celluloses have theoretically the possibility to add pigments to the moulding compound, they generally do not avail themselves of the opportunity because this requires considerable experience. On the other hand, the processing of polyvinyl chloride, irrespective of whether the resin is flexible or rigid, necessitates the use of a mixer in the moulder's plant. Although the common types of mixers with sigma-shaped paddles are successfully employed throughout the industry, a newly developed type of mixer with agitators producing a whirling and disintegrating motion is increasingly used. The barrel mixer by Gebr. Lodige, Maschinen-bau-Gesellschaft m.b.H., Paderborn, employs agitators of the shape of a ploughshare which in combination with rubbing disintegrators produces a free-flowing mixture of powdered polyvinyl chloride and plasticizer. The principle of the operation is based on the fact that powdered polyvinyl chloride absorbs the plasticizer more readily when hot and that, then, the plasticized powder leaves the machine dry (dry powder process). If an additional cooling drum is arranged below the heated drum, larger quantities of plasticizer may be added, and the moulding compound thus produced is ready for subsequent processing without need of granulation. The fluid mixer by Henschel Flugmotorenbau GmbH., Kassel, also produces a whirling motion to obtain the desired result. A rapidly revolving pinned ring rotating in a horizontal plane works in conjunction with a series of stationary pins. During the process of mixing, the machine imparts a rotary and an upward flowing motion to the material, the upward flow being produced by the form of the annular surface. The 25-gallon mixer requires from 1.5 to 2 minutes to process between 75 and 90 lb. of powdered polyvinyl chloride.

Extruding

In addition to injection moulding machines, screw extruders have gained great importance in processing thermoplastics, especially in recent years in Western Germany.

Single-screw extruders commonly have a 15 : 1 ratio of the length to the diameter of the screw, and good results have been obtained with this ratio. The extruder made by A. Reifenhauser, Troisdorf, has a screw of 6 in. diameter and a length which is even 20 times the diameter. Two speed ranges from 6.5 to 28 and from 12 to 52 r.p.m. are available.

The fact that the back flow of the material in the barrel promotes plasticizing has been utilized by Frieseke & Hoepfner GmbH., Erlangen-Bruck. In this company's extruder, the heat required to make the thermoplastic material soft and plasticized is partly produced by shearing action. The extruder contains a hydraulic adjusting mechanism which, by changing the clearance between the barrel and the screw flights, controls and changes the resistance to the flow and, thus, the rate of

back flow. The adjustment may be effected while the machine is in operation. Whereas in this design a part of the driving power is converted into heat and the rest of the heat is supplied by electric heating elements, Alpine A G. Eisengiesserei und Maschinen-fabrik, Augsburg, have gone a step further in designing the model H extruder which has neither heating elements, nor cooling jackets, nor heat and cooling water regulating equipment. The entire heat required to plasticize the material is supplied by way of the driving power. Also the speed change box is eliminated since the screw is powered by a variable speed motor performing at from 500 to 1,500 r.p.m. The $\frac{11}{16}$-in. diameter screw requires 1.5 h.p.

Depending on the sectional shape to be extruded, straight, angular, and cross extrusion heads are used. All extruder manufacturers build such heads of time-tested design. Such is the angular extrusion head by Frieseke & Hoepfner GmbH. designed for coating wires, cables, wire ropes, tubing, strips, and sectional shapes.

A wide range of accessories is available for use in line with extruders. The adjustable pipe haul-off unit which has been newly developed by A. Reifenhäuser can be set to diameters up to 10 in. The equipment can be adapted to use for small diameters by removing a number of haul-off chains till a minimum of three is left. Because the strip or the tube is continuously extruded, the cut-off saw moves at the speed of the extruded strip while it cuts the material. When the cut is completed, it returns to its starting position. The cut-off pieces are stacked automatically.

The manufacture of film and sheeting by means of a flow extrusion head necessitates the use of somewhat more complicated haul-off devices. The tube as it is forced out of the cross head is blown up by compressed air upon leaving the die. After being passed through a cooling unit, it is laid flat by pressure rollers and slit open at the sides. Two strips of sheeting having half the width of the pipe wall are thus produced. It is evident, that laying flat a tube involves the formation of creases since the distances the various points on the circumference of the circular section have to cover are unequal. Paul Troester, Hanover, introduced vaulted guide plates to lay flat tubes after extrusion and blowing. They make the formation of creases impossible.

Plasticizing

Employing the basic principle of mastication and extrusion by screw action, plastics extruders are increasingly employed as plasticators producing a thorough mixture and extruding the plastic stock in the form of strips and strands suitable for subsequent pelletizing in granulators. Multiple-screw plasticators have been found especially useful. In order to improve the plasticizing effect of the screws, designers provide special kneading sections in the screws. A highly efficient design is the double-screw plasticator developed by Werner & Pfleiderer, Stuttgart-Feuerbach. Interrupted by kneading sections, the screw flights in this machine are progressively spaced.

Plasticators of this and a similar type will largely replace kneading machines, and milling rolls to some extent as well. These latter machines operate at low efficiency. Besides, considerable manual work is involved during milling, the material adhering to the mixing roll needing to be detached by knife several times. This also makes it hard to produce a homogeneous and uniform mixture. This is one of the reasons for the increasing use of screw plasticators for feeding calenders. Another reason is the possibility to match plasticator and calender in production capacity and to assure an even flow of properly conditioned material to the calender.

Calendering

Designed for the specialized work of processing plastic stock to film and heavier sheet of accurate and uniform gauge, the four-roll calender is quite indispensable. Although rigid sheeting is frequently made by the blow extrusion process, calendering imparts special, highly advantageous properties to the film thus produced. Built for the production of thin gauge, rigid sheeting, the calender which is manufactured by Hermann Berstoff, Maschinenbau-Anstalt GmbH., Hanover, has four rolls. It is of the I-type. The roll diameter is $19\frac{3}{4}$ in. and the roll length is $47\frac{1}{4}$ in. The design which incorporates all of the manufacturer's extensive experience in calender construction includes such features as roll drive by means of smooth-operating universal spindles from a gear box to which variable-speed motors are flanged for individual drive, electric heating for the water-jacketed rolls, circulation lubrication, individual roll adjustment, etc. Upon leaving the calender, the continuous sheet which has a width of 40 in. and a thickness of 0.0012 in. is given a thermal treatment. Then it is cold worked for added mechanical strength and finally wound up. This production unit is manufactured by Erwin Kampf, Bielstein-Mühlen.

Vacuum Moulding

Vogt & Hartmann, Mainz-Weisenau, who are leading manufacturers of vacuum moulding machines, added to their line of automatic and semi-automatic equipment a new model which they designate as "piccolo" because it is specially adapted for the production of small parts of uncomplicated design. The moulding area in this machine is $25\frac{1}{2} \times 19\frac{3}{4}$ in. It can draw parts to a depth of 2 in. Power consumption is as small as 6 kW.

Manufacturers of plastic parts, who require vacuum moulding equipment for smaller series and short variety runs and who, therefore, give preference to a simple inexpensive machine, make wide use of the moulding machine SH 403/56 by J. Schulte & Co., K.G., Düsseldorf. This model is adapted for the production of articles covering up to 40 × 80 in. by deep drawing and the drape method of forming.

Compression Moulding

Although, owing to the constant development of new synthetic resins, processing equipment for thermoplastics is being continually improved and adapted to changing requirements, compression moulding machines have arrived at a development stage which seems at the moment to be static. Improvements include various cost reducing features and automatic cycle control. New machines are designed for processing modern rapid-setting plastic moulding compounds. The "Bussmann" high-speed moulding press, model HPK, by Hahn & Kolb, Stuttgart, for instance, is equipped with a self-contained oil-hydraulic drive, has infinitely variable moulding pressure regulation from 280 p.s.i. to maximum by hand-wheel adjustment. Because the low pressure section of the pump is laid out to deliver a large quantity of oil, rapid advance and return of the ram are performed at high speed. Accessories enable fully automatic cycle control. Adaptation to the injection-compression moulding of thermosetting plastic material is possible. Special equipment for thermoplastic injection moulding is available.

Moulding presses using low-pressure hydraulic power are required for processing polyester resins reinforced with spun glass. Desirable features include easy accessibility, the possibility of speed variation during the moulding process and easy speed control, as well as slow closing speed in order that entrapped air may escape. These requirements are ideally answered by the low pressure down-working press built by Ankerwerk Gebr. Goller. The press has automatic cycle control, three speeds for the moulding and two for the ejecting operation. The double run-out table adds to the efficiency of the machine inasmuch as the operator may prepare the next charge while the previous charge is being cured.

U.S.A. Production, 1956

10% up on 1955

PLASTICS production passed the four billion pound figure last year by increasing 10% over 1955, it is estimated by The Society of the Plastics Industry, Inc. This is the first time that plastics production has passed this milestone in the history of this 88-year-old industry and it is particularly noteworthy since only ten years ago production was less than one billion pounds.

The total production for all plastics and synthetic resin materials for 1956 is expected to total 4,112,900,000 lb., compared with actual production in 1955 of 3,738,916,000 lb.

Last year's approximate 10% growth comes on top of the 30% increase in plastics production the previous year. For 1957 SPI estimates production will be approximately 5% higher.

The production record set last year also established the plastics industry, for the first time, as a two billion dollar industry. The value of its products in 1956 are estimated by SPI at approximately $2,056,450,000.00. This compares with $1,869,458,000.00 in 1955.

The plastics industry as a whole operated at capacity during 1956. There are indications that this capacity will be increased 5% this year, and SPI estimates that capacity production will continue which will mean an approximate 5% increase in plastics production for 1957, or an estimated 4,300,000,000 lb.

A preliminary analysis of some of the basic plastic raw materials shows increases in some and decreases in others, with no pronounced changes, except for polyethylene and polyesters. Estimated 1956 production for these several raw materials are: polyethylene, 541,128,000 lb., up 30%; polyesters, 71,800,000 lb., up 30%; vinyls, 729,500,000, up 10%; styrenes, 636,000,000 lb., up 4%; phenolics and other tar acid resins, 503,000,000 lb., about the same as 1955; ureas and melamines, 312,000,000 lb., about the same as 1955; cellulosics, 140,000,000 lb., down about 10%.

Year	Production Tons
1922	2,972
1932	14,519
1942	213,365
1952	1,166,962
1953	1,388,313
1954	1,413,901
1955	1,869,458
*1956	2,056,450
*1957	2,150,000

* Estimate by The Society of the Plastics Industry, Inc.

The Properties and Testing of Plastics Materials—Part 9 (Cont.)

Industrial Materials — Special Tests, Properties, etc., Polyvinyl Chloride and Co-polymers

By A. E. LEVER,* A.I.R.I., and J. RHYS,† M.Sc.

Section 7. Polyvinyl Chloride and Co-polymers

THE American Specification (1) for non-rigid p.v.c. covers four types and nine grades, classified according to hardness, and a fifth grade of electrical type.

Type	*Durometer Hardness*
1. Unfilled, D.O.P. plasticizer	70–90
2. Heat and flame resistant ..	80
3. Cold resistant	80
4. Filled	90
5. Electrical	—

A table of properties is given, and the following are of special interest:—

(*a*) Stiffness after heating according to (2).

(*b*) Brittleness after heating according to (3).

(*c*) Oil resistance (4).

The oil should have an aniline point of 70±2° C.

The specimens should be 0.075 in. thick.

(*d*) Deformation under load according to (5), loading unconditioned specimens at 100 p.s.i. at 70° C.

(*e*) Dissipation factor according to (6).

Non-rigid vinyl-chloride-acetate copolymer resin plastics are covered by (7), the types and grades being somewhat similar to the above, as also are the tests. A table of properties is given.

Rigid co-polymer moulding compounds are covered by (8).

Another Specification (9) covers flexible p.v.c. (including co-polymer) tubes. There are General Purpose and High Temperature grades. The procedure for measuring the inside and outside diameters are given, and other points of interest are:—

(*a*) The flammability test is detailed, but it is emphasized that this test is not a measure of the flammability of the compound but of a given tube of certain dimensions.

(*b*) Tensile strength tests are made (10) on small size tube on the length of the tubing, on dumb-bell test pieces cut from the wall of the tube.

(*c*) Heat resistance; both a tensile strength method and a weight loss on heating method are advocated. The G.P. grade is heated for 72 hours at 100° C., and the High Temperature grade at 130° C.

(*d*) Oil resistance (11). It is suggested that this test should be correlated with the Stress Relief Test (see below) since percentage change in ultimate elongation indicates the oil resistance of the specimen, provided it has a minimum of internal strains originally. Specimens with high initial internal strains will, in general, show less change in ultimate elongation than those with a minimum of strain.

(*e*) Brittleness (3). A penetration tester is recommended and details are given.

(*f*) Insulation resistance (12). This is applicable to tubing under $\frac{3}{16}$ in. dia. but may be used for large bores provided the tubing is not kinked in the process of forming the "U" shape.

(*g*) Dielectric strength is determined at normal and high humidity (13).

(*h*) Stress Relief Test. This is intended to provide a measure of internal stress retained in the plastic tubing after extrusion. It indicates, to some extent, the amount of shrinkage which may occur when the tubing is exposed to heat.

Essentially the test comprises immersing the tube in a bath of glycerine at 150° C. for 15 minutes and then measuring the percentage change in length, calculated on 10-in. length.

A British Specification (14) has been issued covering unsupported flexible p.v.c. sheet and film (printed or unprinted). The angle tear piece is used in determining the tear strength. Other tests include extensibility after heating, blocking, colour bleeding and fastness to light. The test for adhesion of the print has been borrowed from the textile industry and is known as the Crockmeter (15); it is a rubbing test. For American data see (16), (41).

Test for p.v.c. compounds for insulating and sheathing grades, taken from the finished cable, are given (17). The statistical significance of the hot penetration test is discussed (18).

Rigid vinyl chloride-acetate sheets are covered in an American Specification (19). There is only one type but three grades, according to the finished surface appearance:—

Press polished both sides.

Matt finished both sides.

Press polished one side and Matt finished on the other.

Apart from the usual tests there is included: (*a*) Modulus of elasticity in flexure (20). (*b*) Flammability (of sheet over 0.050 in. thick) (21). (*c*) Thermal stability (22).

A Specification (23) describes tests for p.v.c. grommets, and these tests are in accordance with (24), except that for loss of weight, which must not exceed 3% on heating.

Two Specifications cover the fabrication of articles from p.v.c. sheeting. The first (25) covers those articles made from sheeting not over 0.012 in. thick, and excluding rainwear. Tests for strength of seams, together with details of the grades of sewing threads which are permissible for various uses, are given. The second Specification (26) deals with the fabrication of rainwear. Seams, pockets, fasteners, etc., and methods of attachment are detailed.

The Commercial Standard 192.53 issued by the U.S. Dept. of Commerce for p.v.c. sheet and film (27) follows the British Standard (28) with some variations in detail. Tear strength is determined by a method used for paper (29).

Methods of testing p.v.c. leathercloth have been issued (30), and they cover also nitrocellulose and oil-coated fabrics. The following is of interest:—

(*a*) **Cloth weight per unit area.**

Three methods are given for the removal of the coated surface, varying according to the composition of the coating.

1. **P.V.C.** The fabric backing is wetted with tetrahydrofuran or methyl ethyl ketone, and the coating mechanically stripped from the fabric.

2. **Linseed Oil.** The coating is immersed in 100 ml. of a 1% aqueous solution of caustic soda at 60-70° C. for 20 minutes.

3. **Nitrocellulose.** The coating is removed by immersing the sample in acetone.

(*b*) **Ballistic Tear Strength**

The Shirley Institute double pendulum ballistic tester is used, and is a form of impact strength test.

(*c*) **Flexing**

The De Mattia or Schildknecht machines are recommended.

(*d*) **Colour Rubbing**

The apparatus is described and consists essentially in rubbing a piece of bleached fabric on the surface of the test piece.

(*e*) **Heat Ageing**

Activated carbon is used for absorbing any volatile.

(*f*) **Surface Tackiness**

An inclined plane method is used, on which a steel cylinder weighing 4 lb. (3 in. dia.) slides down on the face of the sample. The height of the plane when the weight begins to move is recorded.

(*g*) **Flame Resistance**

The inclined strip method is used (31).

A method for the estimation of p.v.c., and co-polymers, in compounds is given (32). The polymer is separated from other materials by dissolving the compound in tetrahydrofurane and precipitating with ethyl alcohol.

Changes occurring in a plasticized p.v.c. were measured electrically by methods given in (33).

A simple apparatus is described for measuring the differential coefficient of expansion and shrinkage during annealing or heat treatment (34). The effect of calender grain direction upon the thermal expansion and contraction is surprisingly large.

Data is presented, and discussed, on the role of hydrogen chloride in p.v.c. degradation. The experimental method is detailed, with a note of its limitations.

The effect of different metallic soaps on transparency and on heat and light stability, when incorporated as stabilizers in p.v.c. is discussed (35).

A short-time stability test for chlorine containing polymers (22) estimates the amount of chlorine given off.

The Congo Red Test for p.v.c. is quite useful as a qualitative test. A 10g sample of the

* Consultant † F. W. Berk and Co. Ltd.

material is cut into chips ¼ in. × ¼ in. × 0.060 in. and placed in a test tube, over the lip of which a Congo Red test paper is placed. The tube is maintained at 180° C., and the time taken for the test paper to show the presence of acid is a direct measure of the heat stability of the material. It only gives results in the induction period. A material withstanding these conditions for 4–8 hours is generally considered satisfactory. Unstabilized materials will give a positive reaction in about 10 minutes. The use of chlorinated extenders will generally reduce the stability.

The ability to recover from extensive and prolonged deformation is an important property of plasticized p.v.c., and it is suggested (36) that measurements of the modulus of elasticity could be used to investigate the nature of the network structure of p.v.c. as a function of temperature, plasticizer concentration, and type of plasticizer. The testing equipment used to cover the complete range of modulus measurements was:—

TESTING EQUIPMENT

Young's Modulus. p.s.i.	Equipment
0.01 to 10 ...	Triple beam Cenco Balance and cathometer.
10 to 1,000 ...	Special low friction compressometer.
1,000 to 50,000 ...	Tinius–Olsen parallel plate plastometer.
50,000 to 500,000	Tinius–Olsen compression set tester and a Baldwin–Southward Universal tester.

In each case the cylindrical specimen was mounted upright on a stationary lower plate and subjected to compression by the upper plate. The system VYNW–DOP was studied and some interesting results are given.

The stability of p.v.c. lattices towards the addition of electrolyte solutions is discussed (37) and test methods are compared. An apparatus which gives a well-defined end point is described and illustrated.

An important test for p.v.c. pastes is the determination of the temperature at which a satisfactory tensile strength is obtained. Samples of the paste are heated in moulds for a standard time (say, 5 minutes), at a series of temperatures of 130° to 180° C. Tensile strength and elongation at break is determined for each temperature. and the results compared with a suitable standard.

A differential thermal expansion apparatus is described (34) which can be used to measure the differential expansion and contraction between rigid vinyls and steel. It consists essentially of an oven containing a steel reference bar with a groove into which the specimen is clamped. A mark is put on the specimen, and its movement relative to a similar mark on the steel bar is measured. The effect of internal stresses is apparent. It was concluded that thermal expansion and contraction depends both on the history and composition of the material. Volume coefficients of expansion of two vinyl polymers was found to be:—

Geon 404 3.0×10^{-4} cc/cc/° C.
Geon 8700 3.6×10^{-4} cc/cc/° C.
(In the range of 25° to 50° C.)

An American Specification (39) covers moulding compounds of co-polymers of vinyl chloride-vinylidene chloride in the form of powder or pellets. One general purpose type is given. The viscosity is determined from a 2% solution in o-dichlorobenzene, using a Ubbelohde viscometer or FitzSimmons modification (40).

In ascertaining the strength properties of polyvinyl chloride/acetate co-polymers, the stress values, as well as the type of failure, are influenced by the velocity of the test (38).

P.V.C. PASTES

Plasticizer (parts 100 polymer)	T.C.P.		D.O.P.	
	80	100	80	100
Viscosity 25° C.–poises ...	400	100	95	18
Tensile strength 20° C. p.s.i. ...	1,900	1,400	1,500	1,100
E.B.% ...	400	400	400	400
B.S. hardness 20° C. ...	69	94	79	104
Low temp. flex ° C. ...	—25	—40	—50	—55
Vol. resist 20° C. ohm/cm. × 10^{-9} ...	8.7	2.4	7.1	3.3

P.V.C. LATICES (42)

	352	652
S.g. ...	1.16–1.18	1.25
Total solids % ...	52–55	50–55
pH ...	8.0–9.5	7.0–8.5
Surface tension dynes/cm. ...	44–52	34–40
Viscosity cps ...	20–30	10–18
Particle size-microns ...	0.2	0.2

Typical Properties

It will be appreciated that any table of properties of p.v.c. (and co-polymers) will be subject to wide variation due to the different types of polymer, amount and types of plasticizers, fillers, etc. The following information, culled from various sources, will give an indication of the values that may be expected. The tables above should also be consulted.

Rigid P.v.c. Sheet

S.g.	1.39
Specific heat cal/g/° C.	0.24
Flow point ° C.	180
Softening point ° C. (Vicat)	90–95
Hardness rockwell R.	70–90
Tensile strength	6,000–8,500
Elongation at break %	85–100
Impact strength Ft. lb./in.²	(unnotched) 22
Young's mod. in bend × 10^4 p.s.i.	45–50
Thermal conductivity × 10^{-4} c.g.s.	3.0–6.0
Coefficient of linear expansion × 10^{-4}	5.0–8.0
Water absorption 20° C. % 7 days	0.02
30 „	0.19
60° C. % 7 „	0.30
30 „	1.40
Mould shrinkage in./in.	0.002–4
Compression ratio	2.0–2.4
Refractive index r_D	1.54–1.55
Resistance to heat (continuous) ° C.	70–80
Surface resistivity, 75% RH, ohm/cm.²	10^{-12}–10^{-13}
Volume resistivity, 75% RH, ohm/cm.	10^{15}–10^{16}
Power factor, 10^6 c/s	0.006–0.020
Dielectric constant, 10^6 c/s	2.8–3.2
Breakdown voltage (Short) v/mil	375–400
Dielectric strength v/mil	700–1,300

Flexible Compound

S.g., unfilled	1.25–1.35
„ filled	1.30–1.70
Tensile strength p.s.i.	1,000–3,500
E.B.%	200–400
Thermal conductivity c.g.s. × 10^{-4}	3–4
Specific heat cal/° C./g	0.3–0.5
Heat resistance (continuous) ° C.	60–80
Water absorption (24 hrs.)%	0.50–1.0
Mould shrinkage in/in.	0.010–0.017
Compression ratio	2.0–2.6
Brittle temperature ° C.	—40 to —60
Volume resistivity ohm/cm.	10^{13}–10^{15}
Dielectric strength (Short) v/mil	600–1,000
Dielectric constant 10^6 c/s	3.5–4.5
Power Factor 10^6 c/s	0.09–0.10

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Patent Review

The following abstracts have been made from specifications at the Patent Office, with the permission of the controller of H.M. Stationery Office. The country of origin for Convention Applications is shown in parentheses. Complete specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 3s. 0d. each (including postage).

B.P. 760,398. Soap holding device. E. A. Webb. To: Gluo-Tux Ltd.

A magnet on a plastic bracket and a disc of magnetic material pressed into the soap.

B.P. 760,421. Miniature electric transformers and chokes. D. L. Johnston. To: Fortiphone Ltd.

In order to avoid stresses in the synthetic resin block in which the transformer is embedded, a minimum thickness is desirable. This is obtained by a combination of a coated metal (U) member with a smaller block.

B.P. 760,426. Machine for closing the ends of flexible tubes of thermoplastic material. To: Uni-Tubo S. A. (Switzerland).

The tube is gripped by jaws and flattened, the flattened ends welded without pressure, then the fusion weld is compressed for accelerating the cooling by contact.

B.P. 760,428. Drinking straws. B. R. Mead, C. R. Mead.

A double tube with a charge of concentrated drink flavouring or soluble food in the annular space between the outer tube and the inner suction passage.

B.P. 760,473. Perambulator hand protector. M. E. Craig.

A sheath with flaps on the handle bar to protect the hands against cold or wet weather.

B.P. 760,480. Injection moulding machines. K. H. Baigent.

The material is rendered plastic, compressed and finally injected directly into the mould from a single cylinder or chamber thus eliminating the necessity of a pre-plasticizing cylinder. A screw conveyor in the injection barrel, motor unit and piston are inter-connected and slidable as a whole.

B.P. 760,495. Delivery-spouts for bottles and other containers. J. Reynolds.

A spout conical in pouring position which can be collapsed within a ring-like portion fitted into the neck of the container for permitting closure of the container with a cap.

B.P. 760,530. Method and apparatus for the continuous production of reinforced plastic articles. To: Libbey–Owens–Ford Glass Co. (U.S.A.).

Reinforced thermosetting plastic panels are formed on a moving surface by partially curing a glass fibre reinforced resin encased in a flexible film, then locating it in a forming medium and finally curing it. The flexible film is stripped off after final curing.

B.P. 760,611. Production of laminates of films of solid polyethylene plastic bonded to other materials. C. R. Bruce, E. H. Dock, R. A. Rose. To: British Cellophane Ltd. (add. to: 723,631).

A modification of the method described in B.P. 723,631 (irradiation of film with ultra-violet light). The film of solid polyethylene plastic is treated on at least one surface with irradiation from an artificial source of ultra-violet light until the bonding properties of the film are improved. The film is then laminated by heat sealing to other solid materials such as metals, paper, certain plastic materials. No improvement has been obtained with glass, porcelain, polytetrafluoroethylene.

B.P. 760,619. Brushes for applying cosmetics. J. Freeman. To: Spa Brushes Ltd.

For applying mascara to eyelashes. The polythene handle is provided with an easily cleaned single row of thin tines projecting laterally and tapering towards their tips.

B.P. 760,735. Method of moulding thermosetting synthetic resin materials. A. C. Barlow, W. G. D. Carpenter, J. B. Cameron, J. M. Griffith, B. J. Phipp. To: Fairey Aviation Co., Ltd. (add. to 706,179).

Refers to the planographic production of designs on the surface of moulded articles during moulding as described in B.P. 706,179 (applying a design to absorbent paper, impregnating it and inserting the paper into the mould before curing is completed). It has been found that a paper thickness of 0.001 to 0.020 in. gives good results with a resin content of the impregnated paper of 20 to 80%.

B.P. 760,751. Process for the impregnation of fibrous material for use in the production of thermosetting synthetic resin laminates. To: Union Carbide and Carbon Corp. (U.S.A.).

Instead of volatile organic solvents, the necessary removal of which is hazardous and may mean economic loss, the fibrous material is impregnated with an aqueous solution of hexamethylene–tetramine and then with a solvent-free novolac resin.

B.P. 760,782. Process for the production of foamed products based on polyisocyanates. To: Farbenfabriken Bayer A. G. (Germany).

B.P. 760,797. Pack or wrapper for sausage casings. F. G. White. To: Oppenheimer Casing Co. (U.K.), Ltd.

Use of a plastic foil of a thickness of 0.0015 in. with an ultra-violet absorbing pigment or dye-stuff which is effective over the wavelength range of 1800–2500 Å giving a clouded appearance to the foil.

B.P. 760,798. Synthetic resin compositions for coating glass fibres. To: Libbey–Owens–Ford Glass Co. (U.S.A.).

A sizing for glass fibres to facilitate fabrication of strands and to improve their handle ability and the adhesion between fibres when used as reinforcements in synthetic resin consists of a hydrolyzate of a vinyl alcoxy silane admixed with film-forming thermoplastic resins.

B.P. 760,845. Packaging methods and means. J. Feasey. To: R. A. Brand & Co., Ltd. (add. to: 733,147).

B.P. 733,147 describes a plastic cover made by spraying over one or more formers a synthetic resin solution which produces a continuous substantially moisture vapour-proof plastic skin. A greater impermeability to moisture vapour is obtained by using intermediate (polythene) layers of greater impermeability than sprayed plastics.

B.P. 760,920. Seaming of thermoplastic sheet material. C. F. Brouncker.

A neat joint, e.g. for bias binding of nylon, is produced without sewing by fusing the edges of the material together while in continuous motion. The machine comprises a drum and a metal pressure band, heat applying means and a cutting device for edge trimming.

B.P. 760,931. Method and apparatus for manufacturing a sheet material surfaced with thermoset synthetic resin. J. Marian (Sweden).

Sheet products, capable of being wound up and having a decorated face covered by a hard layer of a thermosetting resin can be produced in the following way. One face of absorptive sheet material is coated with a thermosetting resin of such a consistency that it only partly penetrates into the material. The dried sheet is then subjected to heat and pressure simultaneously to produce curing to the C-stage, whereupon it is immediately wound into a roll with the impregnated strip facing outwardly.

B.P. 760,934. Packaging. To: Celanese Corp. of America (U.S.A.).

For packaging foodstuffs and maintaining their freshness, appearance and edibility. The covering (foil) is made from a copolymer of an amide with acrylonitrile.

B.P. 760,939. Personal sanitary conveniences. S. Gaillard.

A urinal which can be fitted to the wearer for day or night use. The receiver is made of a polyethylene or especially polyvinyl chloride film of from 0.0025 to 0.005 in. thickness, which is inexpensive and easily replaceable.

B.P. 760,978. Buttons or like fastenings. S. E. G. Lindblad. To: W. A. Turner, T. S. Kiaer.

A button with a stem ending in a ball which is pushed into the central hole of a flat disc with a reinforced rim. The disc of a resilient plastic resists removal of the stem by straightforward pull but can be folded between finger and thumb for easy release.

B.P. 760,989. Polyvinyl chloride sheet articles. A. D. Clarke. To: Commercial Plastics Ltd.

Sheets used in making rainwear normally of a thickness of 0.003 to 0.008 in. have extending within the hem a length of nylon monofilament of 0.020 to 0.022 in. For sheets up to 0.012 in., a filament of 0.030 in. dia. has proved suitable.

B.P. 761,037. Thimble and manner of manufacturing the same. R. Towers (South Africa).

A moulded plastic thimble with an integral shroud portion to guard a radially disposed razor-sharp steel blade edge at the rim directed towards the front end of the thimble.

B.P. 761,046. Construction of hollow bodies such as artificial limbs. Airscrew Co. and Jicwood Ltd.

Resin applied before, during or after wrapping of glass matting around a former serves to key the fibres together. When the resin has set a homogeneous composite hollow structure is obtained.

B.P. 761,075. Treatment of sheets or webs of thermoplastic materials. Bleachers' Association Ltd., C. J. Whitelegg, F. L. Barrett.

An ornamental effect is produced by bringing about shrinkage of localized areas of woven or non-woven sheets, e.g., of "Terylene" by means of radiant heat applied through a heat resisting screen. For bathroom curtains and similar materials.

B.P. 761,080. Microporous thermoplastic materials. E. M. O'Conor, C. R. Hardy. To: Pritchett & Gold and E.P.S. Co., Ltd.

Microporous polyvinyl chloride used for battery separators is given dimensional stability by a brief period at a high temperature.

B.P. 761,106. Shoes. R. J. Marci, J. A. C. Kavanagh (Karamar Co.) (U.S.A.).

A polyethylene shoe counter moulded to fit loosely on the last and having an integral heel seat flange. It is fastened at its forward end to the insole. It can be used in any one of a number of different widths and sizes.

B.P. 761,112. Manufacture of composite structures of foamed polyurethane. Farbenfabriken Bayer A. G. (Germany). A structure composed of a hard foamed polyurethane composition and a skin of material of higher tensile strength is produced by applying the composition to a surface of the skin which has been pretreated with a reaction accelerator for the foaming process. Used, e.g., for aeroplane wings.

B.P. 761,117. Typewriting machine with a sheet support of transparent synthetic material. Olympia Werk A. G. (Germany).

The support consists of several individual (trapezoidal) supports one of which is equipped with a ruler and scale. Thus no individual support exceeds a certain size.

B.P. 761,134. Production of slit reels of flexible sheet material. B. Samways, J. A. M. Thorne, M. F. Hannaford. To: British Cellophane Ltd.

A continuous reciprocatory axial movement is imparted to the parent roll from which lengths of sheet material are unwound to be slit and rewound. This movement eliminates the cumulative effect of "hard bands" and "soft bands" (regions of greater or less thickness across the width).

B.P. 761,137. Machine and method for producing a laminated corner-bead. F. S. Boldrin, W. C. Boldrin. To: A. H. Dunlap.

Particularly useful in constructing houses using plaster board for inside walls to guard the corner between two abutting angularly placed sheets. Core strip (metal or plastic) and paper tape are continuously drawn from supply reels, subjected to treatment and cut to length.

B.P. 761,238. Sheet material for floors and walls. L. H. Griffiths, W. Saul. To: Semtex Ltd.

Use of a single-phase binder (24 to 50% by weight) based on a plasticized copolymer of vinyl chloride and vinylidene chloride.

B.P. 761,263. Respiratory masks. F. R. Stanley, J. A. Churchill. To: Martindale Electric Co., Ltd.

With a cup moulded of polythene of isosceles triangular form.

B.P. 761,345. Table game. H. S. Alper. To: Soccerette Ltd.

A football or ice-hockey game with plastic board and plastic figures of players and with magnetic operators.

B.P. 761,353. Bowls for domestic sinks. W. Shipworth.

With laterally projecting ribs providing horizontal seating faces of different heights below the rim of the bowl by which the bowl can be seated at different heights from the base of the sink.

B.P. 761,364. Bonding of fabric. J. A. Rhys. To: P. D. S. Young, D. A. Leader.

Fabric or filamentary sheet material is bonded together previously with a polyester resin impregnated or coated surfaces by wetting the fabric, etc., with a stabilized monomer and a polymerization promoter.

B.P. 761,365. Lighting fittings. J. G. Holmes. To: Holophane Ltd.

Transparent plastics fittings having prismatic fluted or other ribbed conformations on both inner and outer surfaces. At least some of the ribbed conformations on the inner surface are machined so that their shape is not conditioned by a moulding tool which must be withdrawable.

B.P. 761,370. Synthetic resins and their manufacture. Farbenfabriken Bayer A. G. (Germany).

Containing a siloxane component and a polyester component.

B.P. 761,379. Window dressers' dummies for garments. R. Benbow & Co. (Modern Shopfitters) Ltd., D. R. Benbow.

The upper structure is formed from strip plastic, the extensions of plastic covered wire.

B.P. 761,569. Method and apparatus for treating plastic material. To: L. Andonart (France).

Gelatination treatment characterized by submitting the mixture to successive gelination treatments each consisting of stirring, compressing, thermal treatment and release of pressure. All liquid or gaseous components are drawn off during the release of pressure except after the last gelatination treatment. The machine comprises a series of successive extruding sections.

B.P. 761,632. Counting devices or appliances for use in the education of children. C. A. Tacey. To: Philip & Tacey Ltd. A moulded frame with a number of parallel slots end movable "counters."

B.P. 761,641. Process and apparatus for the production of tubes. To: Farbenfabriken Bayer A. G. (Germany).

Polymer tubes reinforced with fibres of glass, polyamides or cellulose derivatives. The fibres are drawn through a polymerizable mass into a space between a mandrel and a hollow element open on both ends which is heated to polymerize the mass. The process is continuous.

B.P. 761,650. Closure device. L. G. Bonner. To: Hercules Powder Co.

A frangible plastic closure is used instead of metallic-type closures for the discharge nozzle of jet-actuated devices so that it may readily and completely be pulverized. It operates simultaneously as a pressure and moisture seal and as a pressure release when excessive pressure is generated in the gas-producing unit. For multi-nozzle, optional thrust units.

B.P. 761,833. Method of making decorated sheet material. To: United States Rubber Co. (U.S.A.).

A thin layer of resinous film-forming substance is printed as a solution on a carrier (paper) sheet and dried. Next a design is printed on this layer, preferably from a resinous ink, and dried. Finally the body layer of the resinous film-forming substance is printed over the printed design. The finished film is fused and stripped from the carrier as a unitary sheet with a true sharp reproduction without loss of colour.

B.P. 761,868. Polysiloxane adhesives for pressure sensitive adhesive tape. To: Connecticut Hard Rubber Co. (U.S.A.).

B.P. 761,871. Refractor members for lighting fittings. General Electric Co., Ltd., H. M. Ferguson.

A methyl methacrylate street lighting fitting. A bowl carries sets of parallel arcuate prisms formed by rotation of a cutting tool in one operation on the surface of a plane member which can be bent to conform to the shape of a part of the side of the refractory bowl.

B.P. 761,891. Security device for strap buckles. To: G. Q. Parachute Co., Ltd.

Refers to locking devices for a parachute harness. A handling tag of plastic material is moulded on the spring steel clip of such a shape that it can be grasped even by a person wearing gloves.

B.P. 761,924. Flexible packings or wrappings. J. W. Randall. To: John Dickinson & Co., Ltd.

B.P. 761,928. Acrylic interpolymers and coating compositions containing same. To: E. I. Du Pont de Nemours & Co. (U.S.A.).

Interpolymers of acrylonitrile, an alphaolefinic monocarboxylic acid and an alkyl acrylate. For coating magnet wire but also for leather, paper, textiles.

B.P. 762,025. Liquid dispensing devices. E. K. Cole Ltd., A. B. Glanvill.

An attachment to a flexible plastic bottle in the form of a cup with an inclined stem provided with a passage and projecting upwardly from the side of the cup. It is to be pushed into the bottle neck.

B.P. 762,052. Process for the manufacture of coloured articles from plastic material reinforced with textile fibres. M. P. de Vinzelles.

Articles of plastics reinforced with glass fibres can be mass coloured by loading an outer layer of resin with pigments or chemical dyes dissolved in one of the mother solvents of the resin used. The main charge of resin impregnated fibres is applied on to the initial deposit of the layer of resin containing the dye.

B.P. 762,082. Liquid containers. P. J. Schofield. To: Imperial Chemical Industries Ltd.

Semi-rigid non-metallic or metallic fuel and oil containers with a flexible diaphragm. The flexible material is made up of a synthetic rubber with layers of an organic polyisocyanate modified alkyl resin.

B.P. 762,092. Process for improving the flow properties of thermosetting resin moulding compositions. To: Chemische Werke Albert (Germany).

The moulding compositions are charged with the vapour of a solvent capable of swelling the resin without dissolution.

B.P. 762,096. Manufacture of sheet material composed of unwoven resin-bonded fibrous material. F. T. Crocombe. To: Boulton Paul Aircraft Ltd.

Glass fibres are impregnated with uncured polyester resin, wound on to a former and curved under pressure. The cured mass is then cut open. A laminate is prepared from a plurality of layers with the threads of one layer disposed at an angle to those in the other layer.

B.P. 762,126. Swimming fins. S. J. Clark.

The device is reversible without alteration for use on either foot.

B.P. 762,150. Method of coating articles of cellular rubber with a plastic and articles so produced. To: United States Rubber Co. (U.S.A.).

A core of soft vulcanized cellular rubber and an outer coating of dense fused plastisol. For cushions, arm rests, sandals, underwater swim suit.

B.P. 762,204. Display stands. L. M. Manwaring.

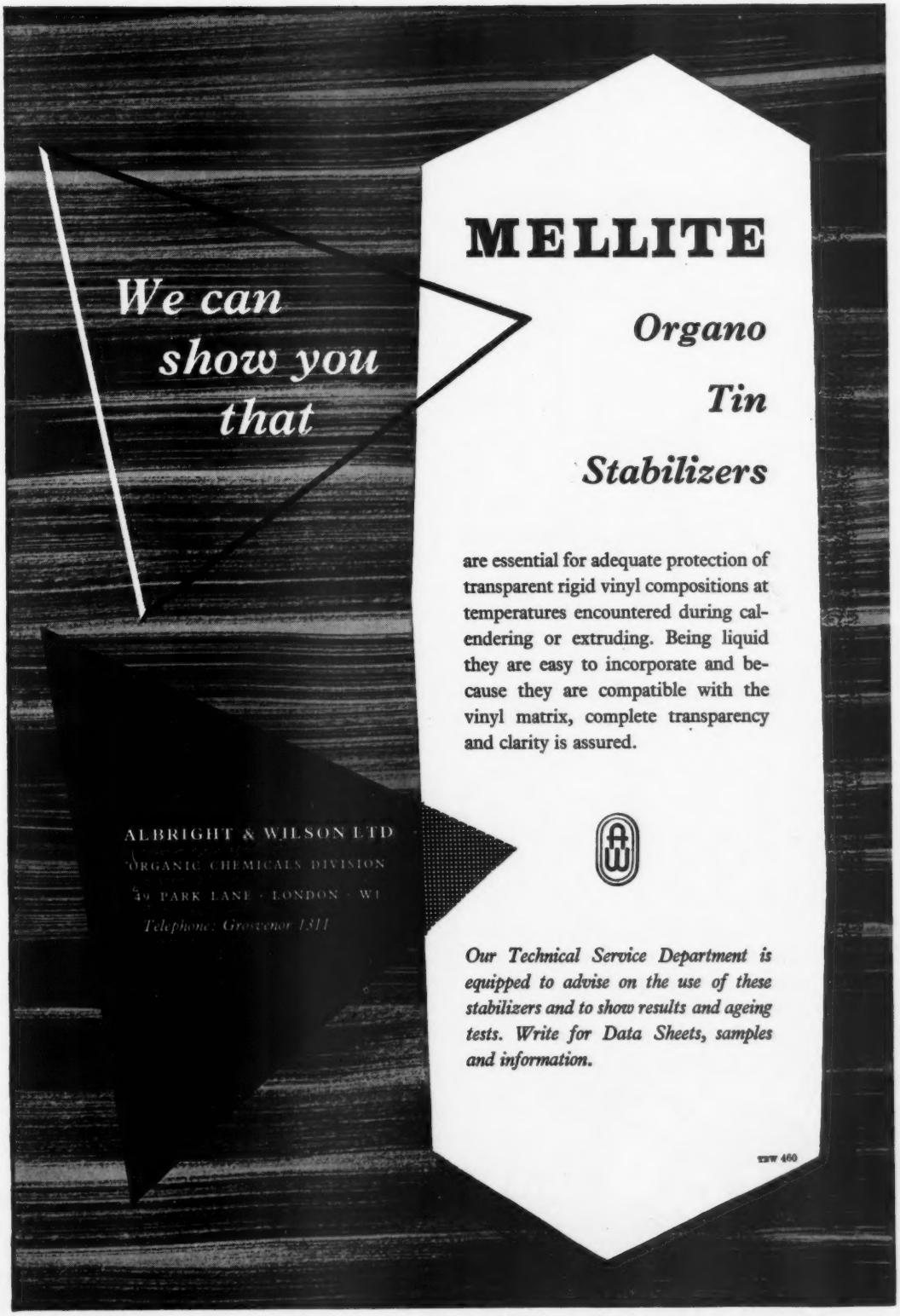
A rotatable stand with translucent plates, illuminated from the interior of the base.

B.P. 762,216. Manufacture of resins. To: Devoe & Raynolds Co. Inc. (U.S.A.).

Refers to high melting point high molecular weight epoxide resins.

B.P. 762,264. Method of, and apparatus for, making bags from tubing of thermoplastic or thermoplastic-coated material. A. Finke. To: A. Windmoller, F. Holscher.

The tubing is transversely cut into bag lengths, which are fed in succession to a sealing device with a series of sealing stations. The rear end of each bag is sealed, the leading end gripped, then the bags are detached and delivered in piles.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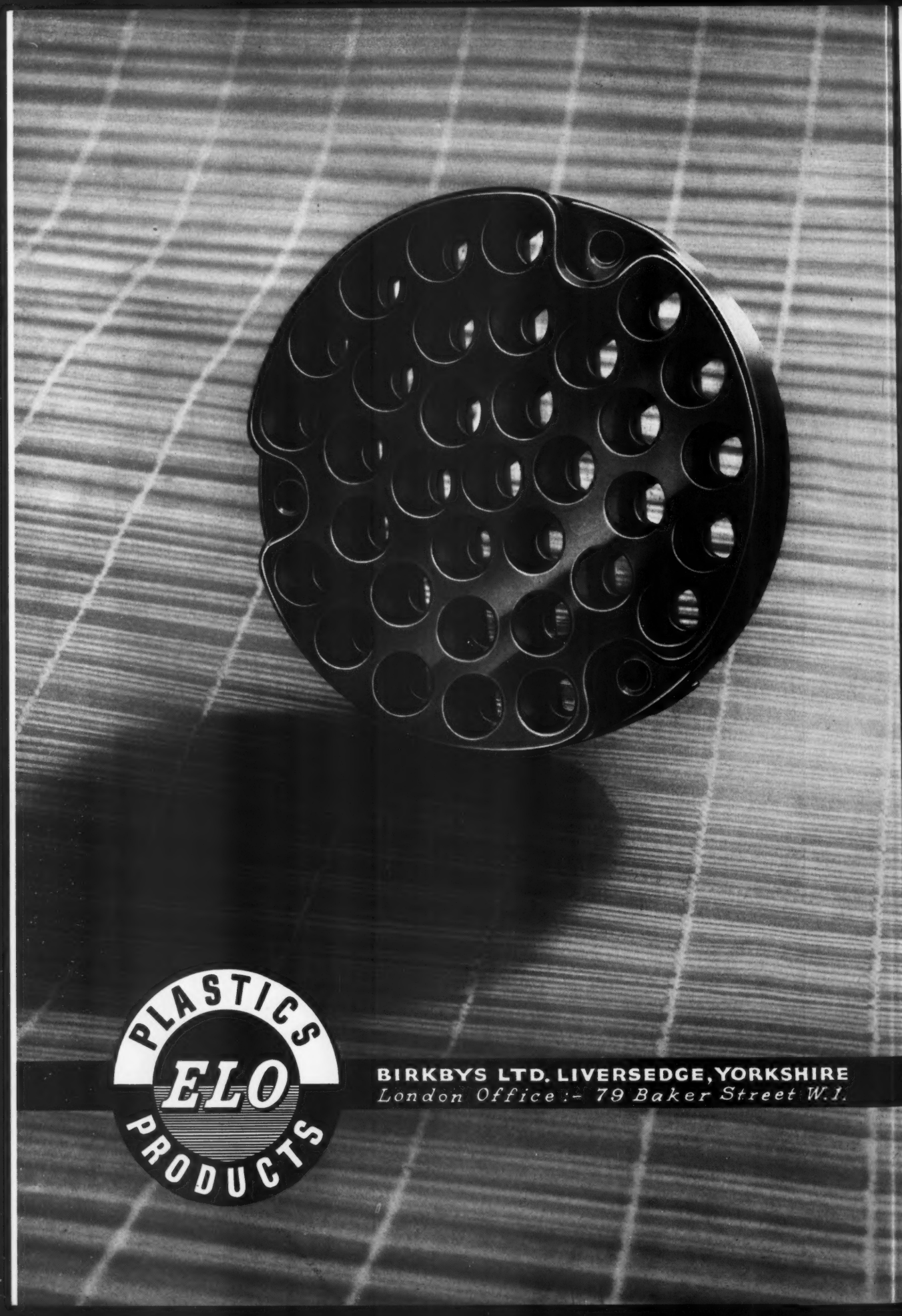
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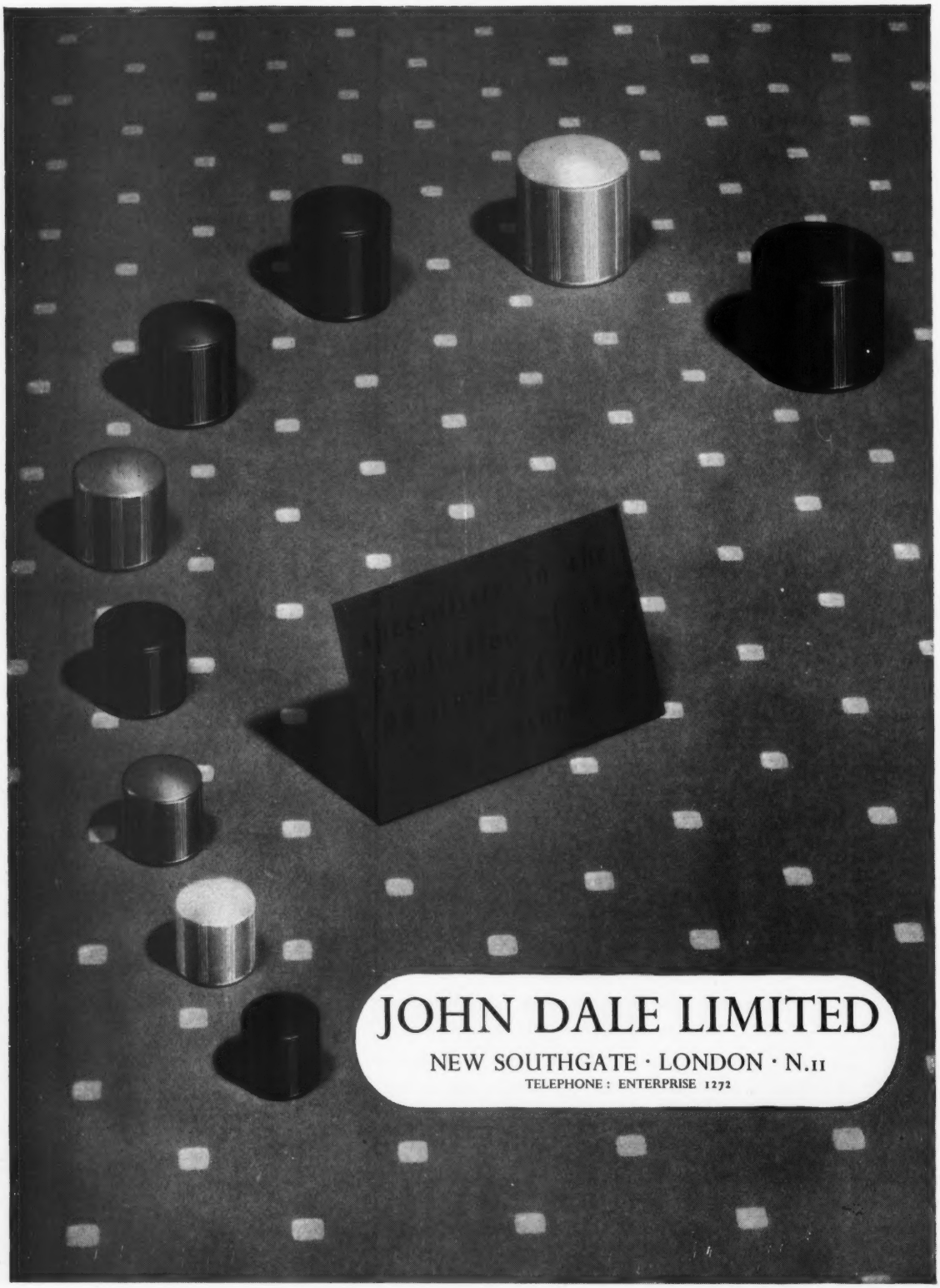
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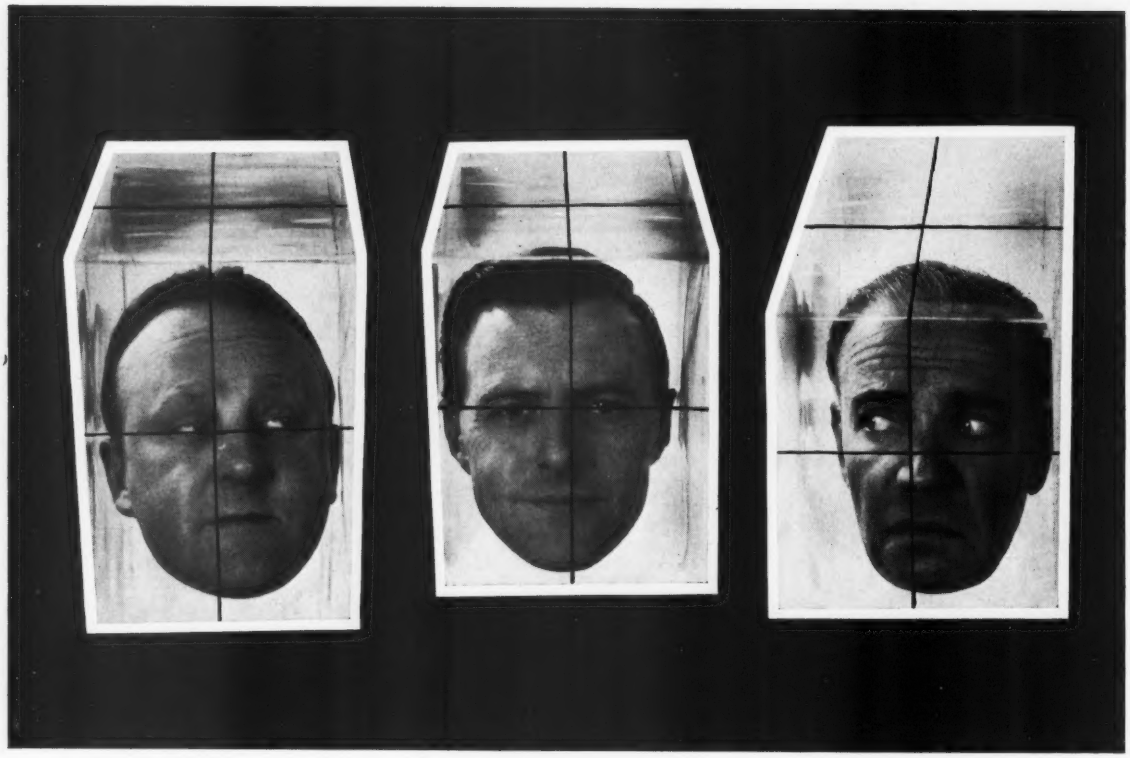

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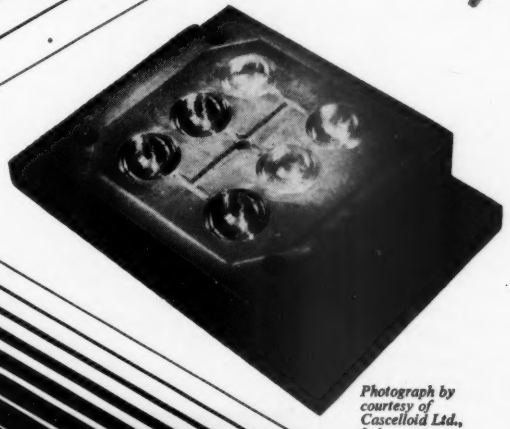

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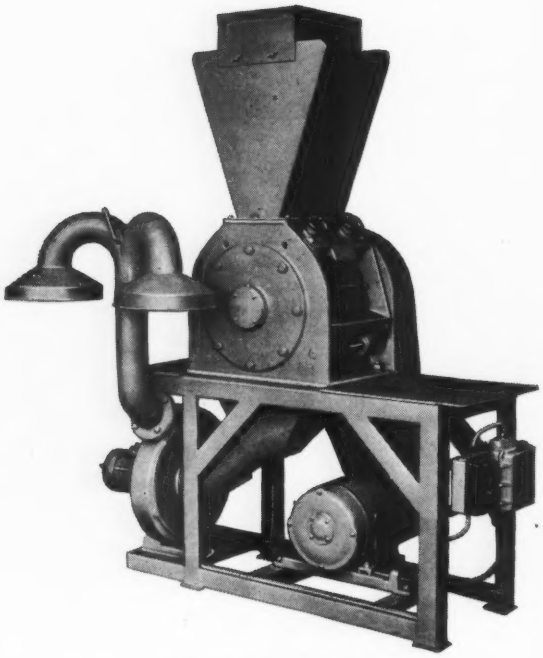

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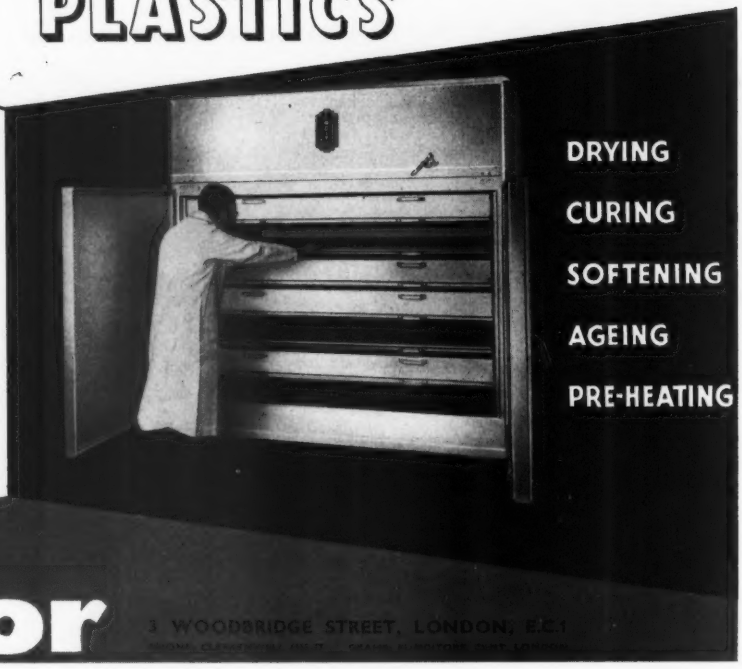

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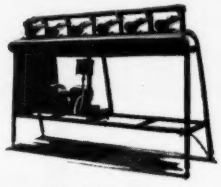

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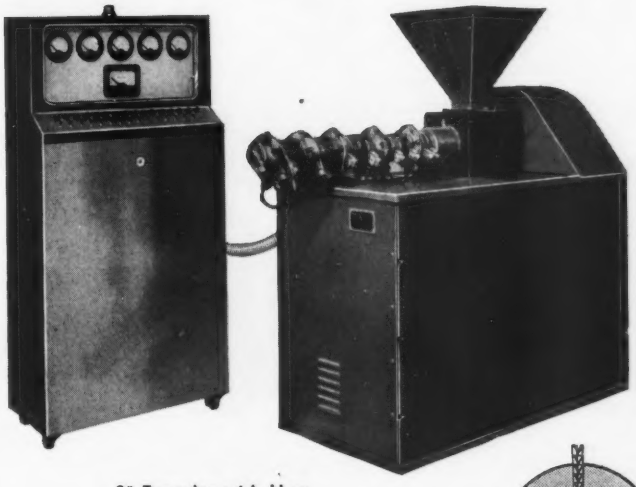

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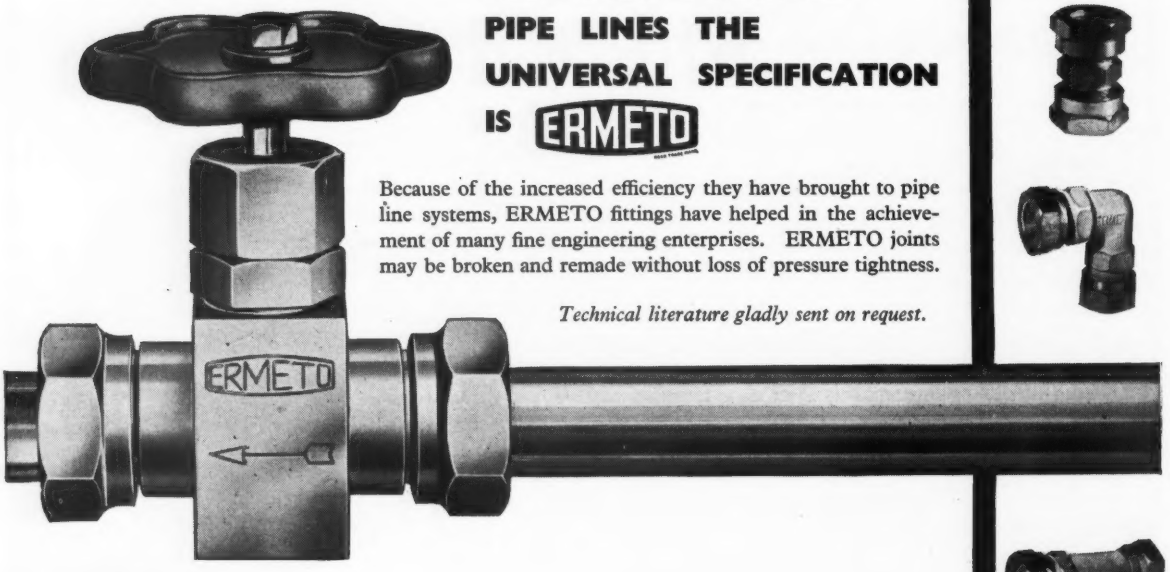

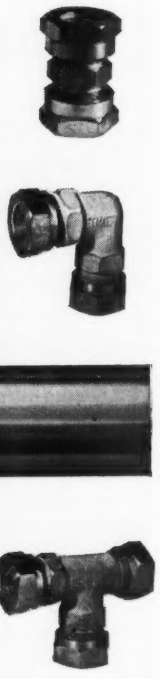

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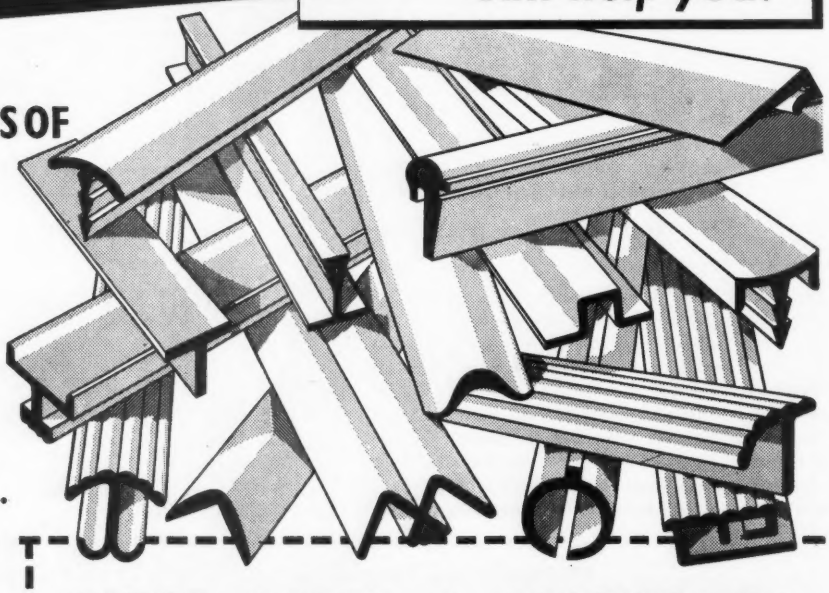

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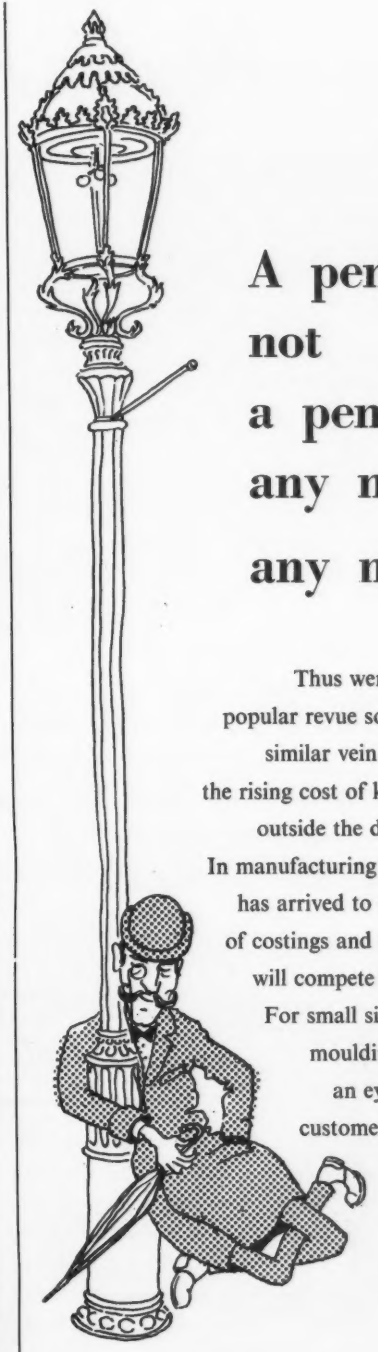

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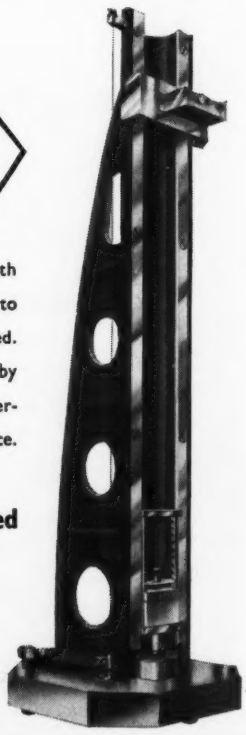

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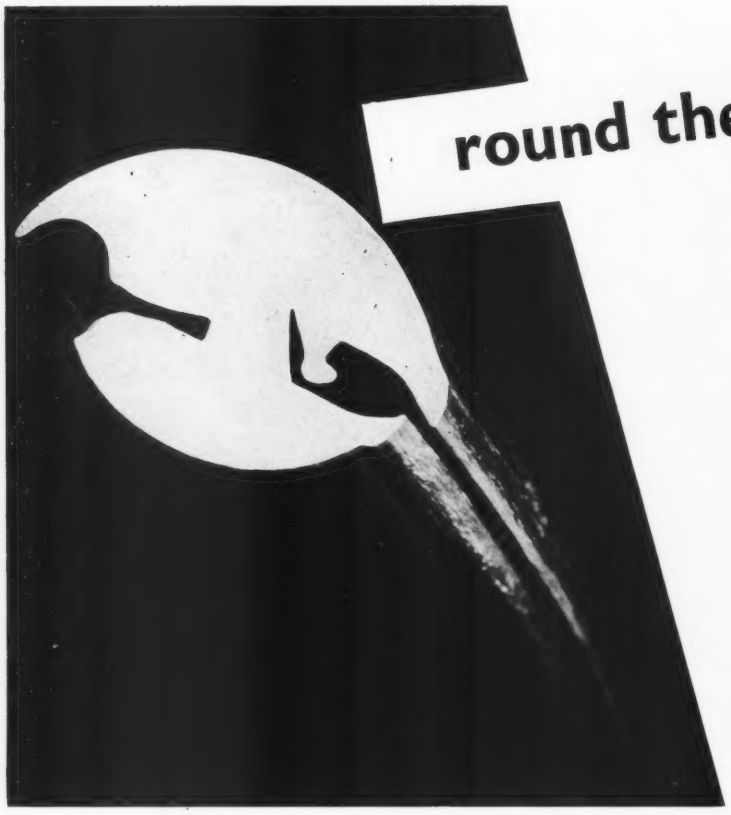

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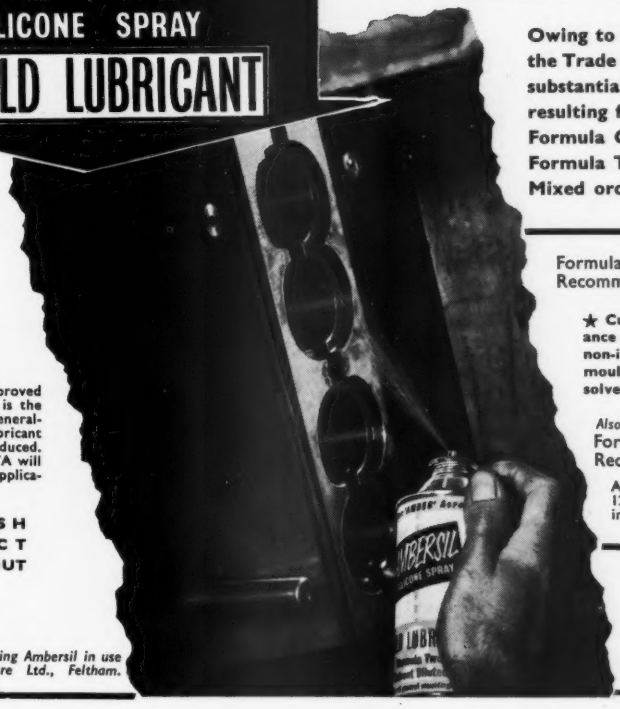

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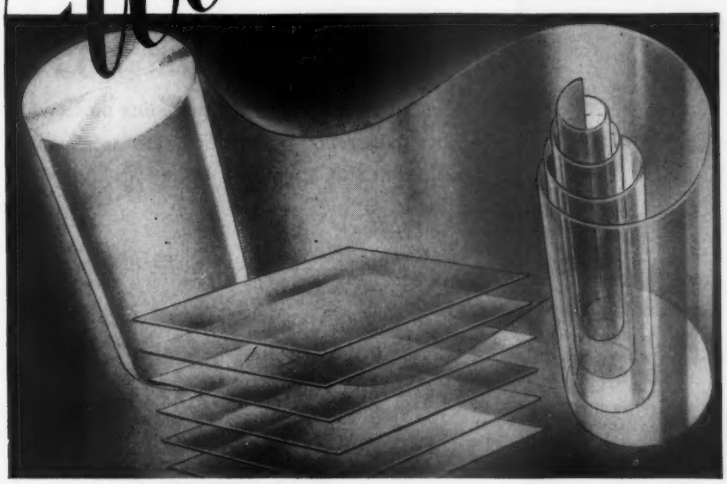

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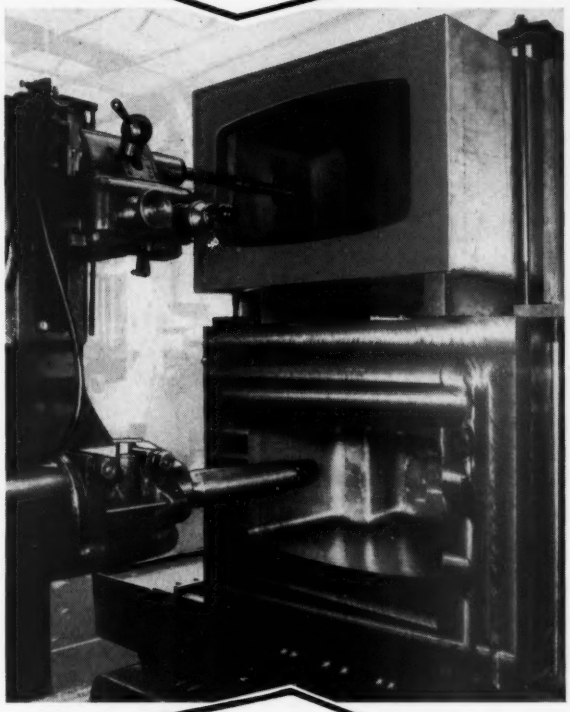

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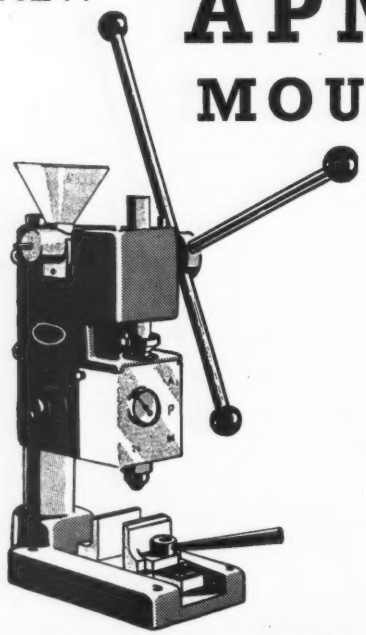

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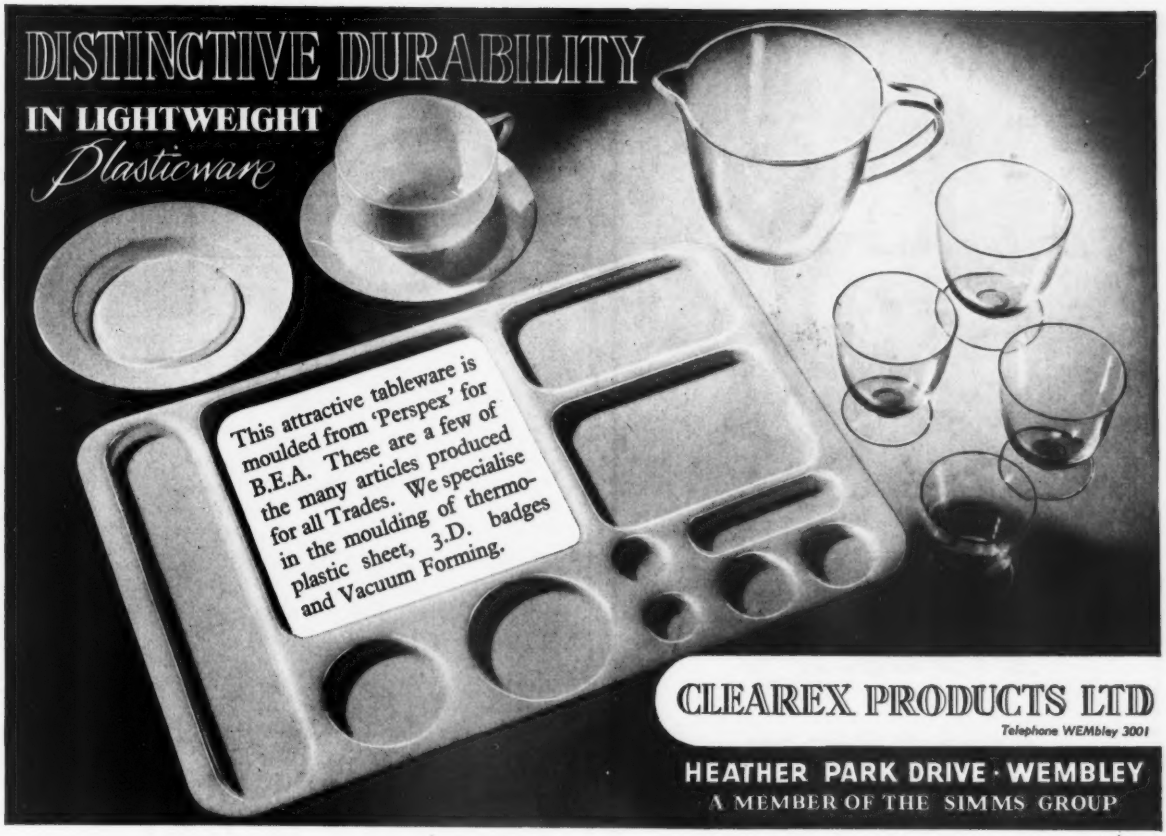
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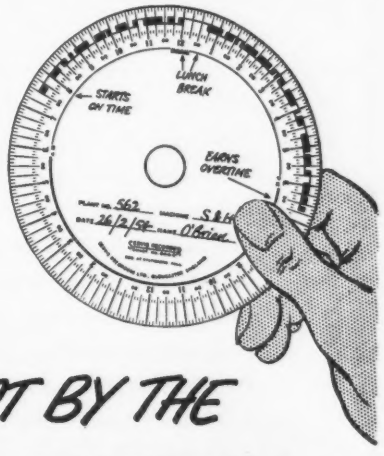

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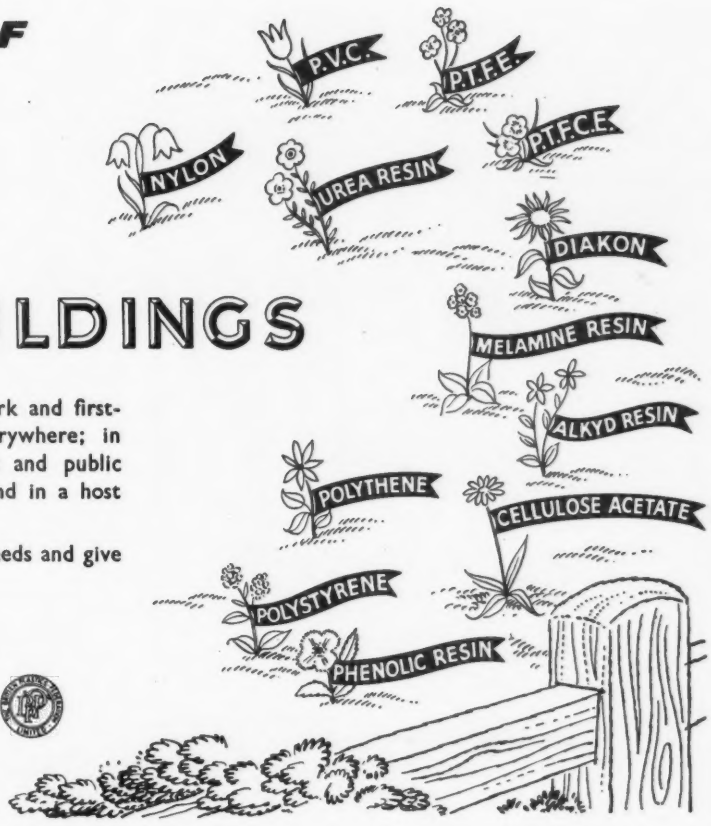

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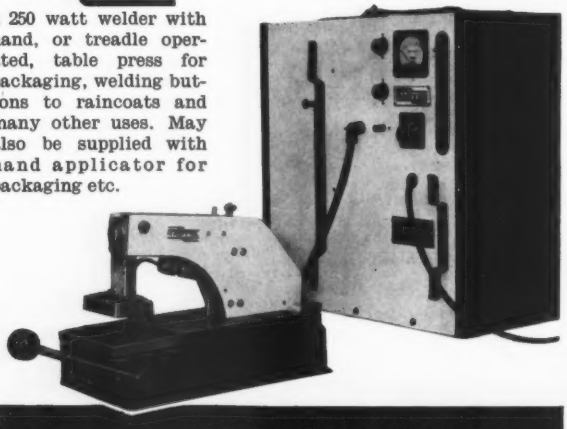

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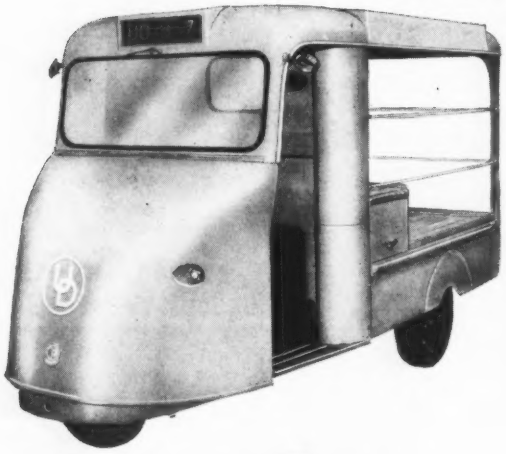

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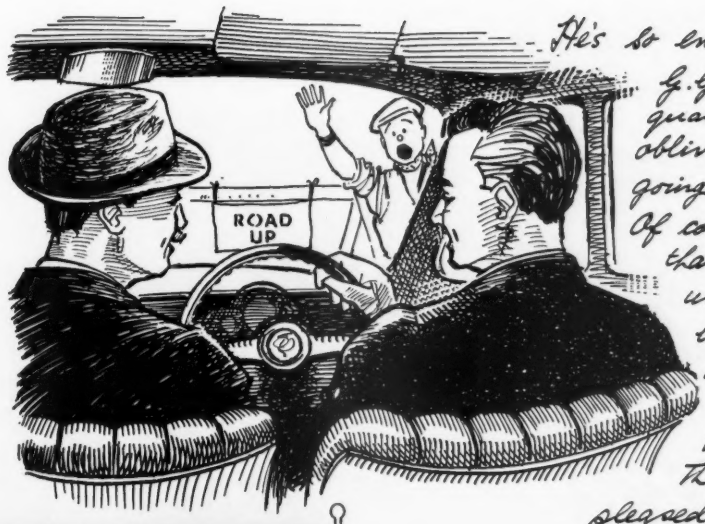

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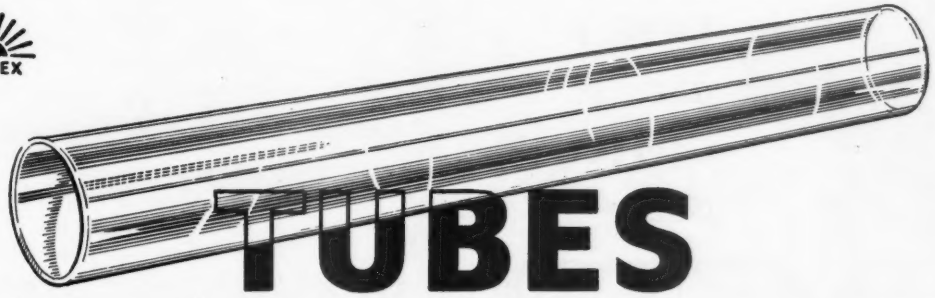

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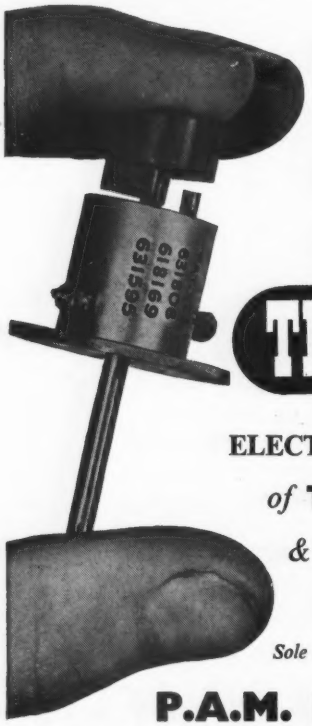

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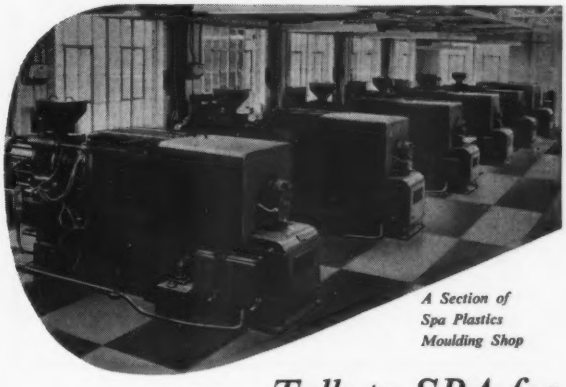

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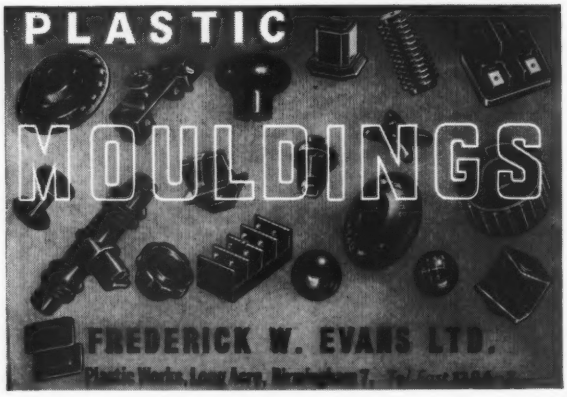

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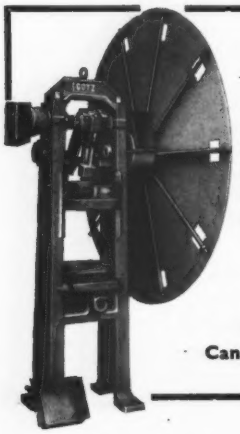

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PLASTICS CHEMIST, preferably a chemistry graduate, specializing on vinyls, required to act as deputy to technical manager of expanding chemical firm in north west, supplying raw materials to the plastics industry. Age preferably 30–35. Salary in accordance with experience and qualifications. Box P3312, care of " Plastics." 233-19

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Plastics

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